Neutral Wind Meter (NWM)
and
Ion Velocity Meter (IVM)

Coupled Ion-Neutral Dynamics Investigation (CINDI) Confirmation Review for NASA

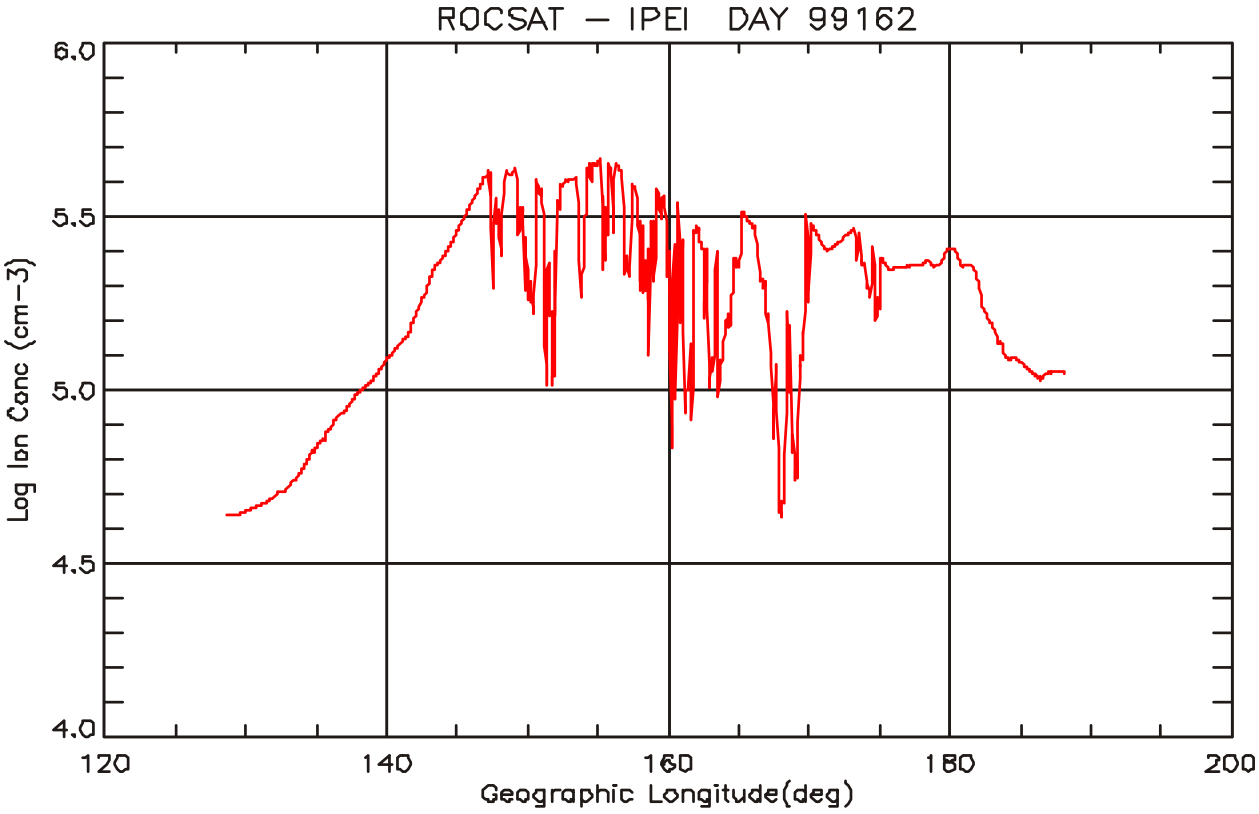
August 29, 2001
UTD

AGENDA

8:15 - 8:20	Welcome, Introductions	Rod Heelis
8:20 - 8:25	Review Board Purpose and Scope	Bill Gibson
8:25 - 8:40	Science Overview	Rod Heelis
8:40 - 8:50	Project Management - Organization	Ron Lippincott
8:50 - 9:10	Project Management - Schedule	Ron Lippincott
9:10 - 9:25	Project Management - Risk Management	Ron Lippincott
9:25 - 9:35	Project Management - Review Process	Ron Lippincott
9:35 - 9:55	Systems Engineering	Ben Holt
9:55 - 10:05	Verification	Ben Holt
10:05 - 10:25	Performance Assurance	Larry Harmon
10:25 - 10:40	Break	
10:40 - 10:55	Instrument Overview	Ben Holt
10:55 - 11:10	Integration and Test	Ben Holt
11:10 - 11:15	Spacecraft Integration Support	Ben Holt
11:15 - 11:25	Flight Operations	Rod Heelis
11:25 - 11:35	Data Analysis	Rod Heelis
11:35 - 12:05	Project Management - Cost	Ron Lippincott
12:05 - 12:35	Summary Review and Action Item Discussion	Bill Gibson
12:35 - 1:30	Lunch	
1:30 - As Required	Caucus of Review Team	Bill Gibson

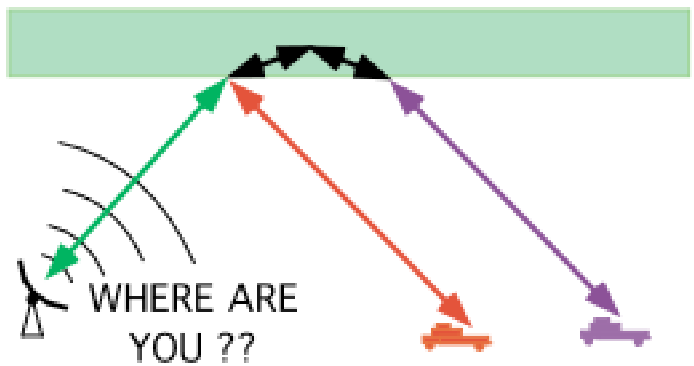
SCIENCE OVERVIEW

APPEARANCE OF PLASMA STRUCTURES

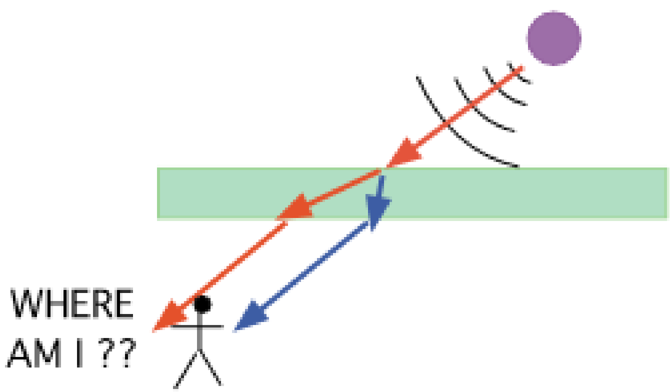


In-situ plasma density measurements show a broad spectrum of horizontal scales and a broad spectrum of depletion magnitudes.

EFFECTS OF PLASMA STRUCTURE ON RADIO COMMUNICATIONS



High Frequency radio waves are reflected and refracted from the ionosphere.
Uncertainties in the propagation path lead to object location errors.



Navigation and communication beacons radiate signals that become distorted by ionospheric structure.
Distortions lead to signal loss due to phase and amplitude variations.

OCCURRENCE OF PLASMA STRUCTURE
MAJOR ISSUES

Top Level Questions

What is responsible for the variations ?
Can they be understood well enough to predict ?

Major Considerations

Climatology

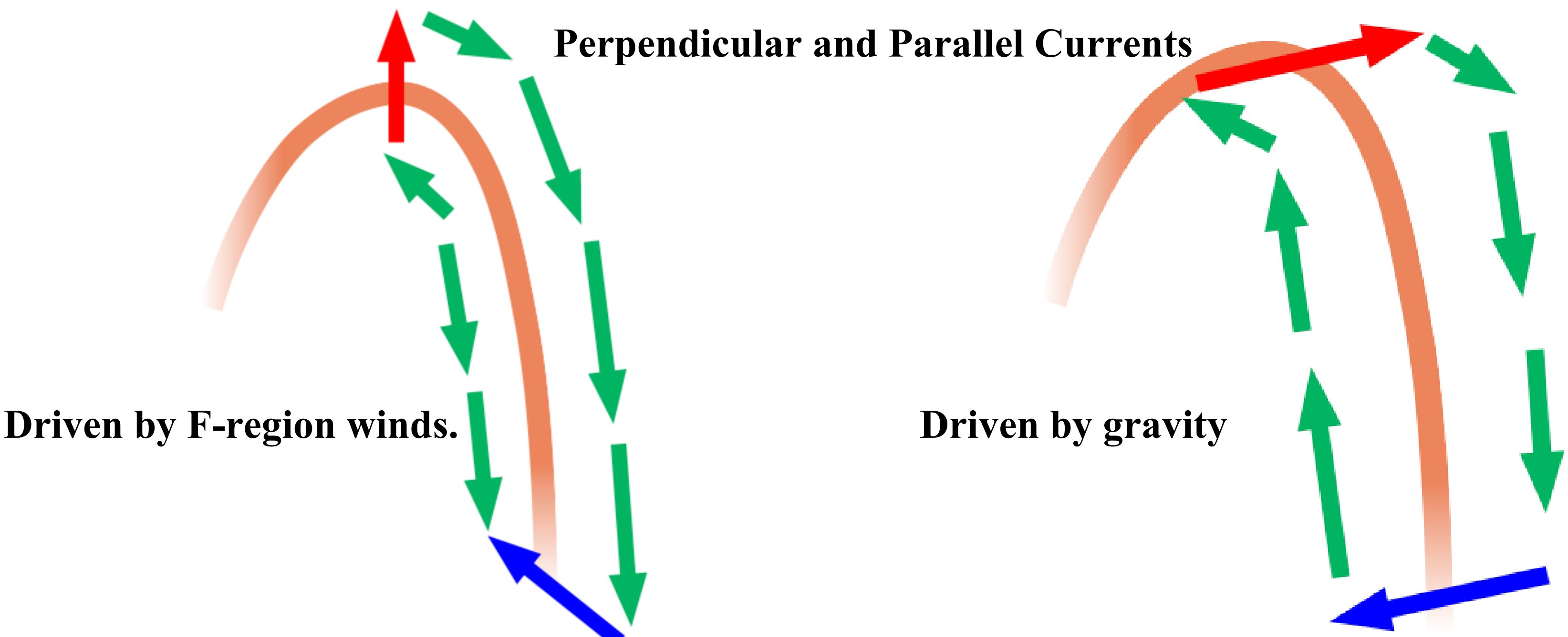
- **Seasonal/longitude variations in electric fields.**
- **Seasonal/longitude variations in seed perturbations.**

Weather

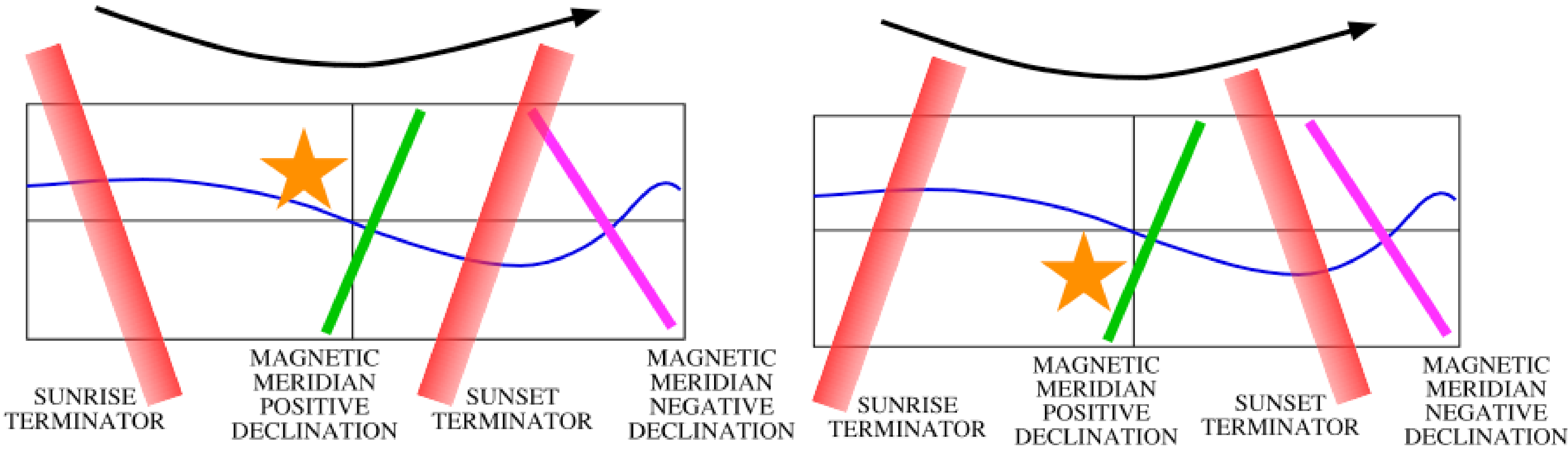
- **Daily variations in electric fields.**
- **Daily variations in neutral winds.**
- **Daily variations in seed perturbations.**

PHENOMENOLOGY

- **Enhanced vertical ExB dynamo drifts and bubble plasma drifts are produced by F-region polarization fields.**
- **Large Scale Polarization Fields map along the magnetic field and may be shorted-out through a conducting E-region.**
- **F-region fields most effective when E-region is in darkness at both ends of magnetic field.**



CLIMATOLOGY



SUMMER

Magnetic Meridian with Positive Declination
Aligned with Sunset Terminator

WINTER

Magnetic Meridian with Negative Declination
Aligned with Sunset Terminator

DAILY VARIATIONS IN PLASMA STRUCTURES

- **Variations in the seed perturbations**
  Gravity **waves** from weather systems
- **Variations in the height of the F-peak**
  Local-time history of the vertical **ExB drift**
  Magnitude and persistence of the post-sunset enhancement.
  Neutral winds.
- **Variations in the flux-tube integrated conductivity**
  Neutral wind induced field-aligned plasma motions.
  ExB drift history

PLASMA STRUCTURES -- CINDI QUESTIONS

- **What are the relationships between the behavior of F-region neutral winds and the daily variability of ExB drifts ?**

- **How do F-region neutral winds and ExB drifts influence the evolution of irregularities ?**

CINDI MEASUREMENT APPROACH

Ion Density and Drift Velocity

Retarding Potential Analyzer (RPA)
to measure kinetic energy of ions along the sensor look direction.
Ion Drift Meter (IDM)
to measure ion arrival angle with respect to sensor look direction.

RPA and IDM measure incoming ion flux and thus ion density.

Neutral Wind Velocity

Ram Wind Sensor (RWS)
to measure kinetic energy of neutrals along the sensor look direction.
Cross-Track Wind Sensor (CTS)
to measure neutral arrival angle with respect to sensor look direction

IVM OPERATIONAL PROFILE

IDM

Horizontal / Vertical fixed or alternates every 1/8 or 4 secs
Difference Amplifier Output Sampled at 128 Hz
16 bit samples
4 Log Amp Outputs Sampled sequentially at 16 Hz
16 bit samples

RPA

Retarding Grid Voltage Stepped at 32 Hz
Sweep Sequence Selected from Memory; One of 8 Blocks with 32 Locations
32 Steps can comprise 1 sweep ; 2 sweeps ; 4 sweeps
Electrometer Output Sampled at 32 Hz
16 bit samples

Total Telemetry Rate 3072 bps including housekeeping and packetization

NWM OPERATIONAL PROFILE

CTS

Horizontal and Vertical arrival angles measured separately with
2 Difference Amplifier Output each Sampled at 16 Hz
16 bit samples
4 Log Amp Outputs Sampled sequentially at 16 Hz
16 bit samples

RWS

Retarding Grid Voltage Stepped at 32 Hz
Sweep Sequence Selected from Memory; One of 8 Blocks with 32 Locations
32 Steps can comprise 1 sweep ; 2 sweeps ; 4 sweeps
Electrometer Output Sampled at 32 Hz
16 bit samples

Total Telemetry Rate 1536 bps including housekeeping and packetization

CINDI SUCCESS CRITERIA

Minimum Success Criteria

Science

Describe the local time dependence of the zonal wind at the equator
What are storm influences ?

Operations

Quality Data from NWM below 450 km for ~40 day period
- **Ascending node rotates 24 hours in local time**
- **Line of Apsides rotates at least 360^{o}**

Mission

Data integrated into CINDI data system and delivered to NSSDC

CINDI SUCCESS CRITERIA

Comprehensive Success Criteria

Science

Describe the local time and seasonal dependencies in zonal and meridional neutral wind at the equator.

Describe the local time and seasonal dependencies in zonal and meridional ion drift at the equator.

How does the appearance of plasma structure affect the ion and neutral motions ?

Operations

Quality Data from NWM and IVM below 450 km for ~270 day period

Ascending node rotates 24 hours in local time at solstices and equinox

Line of Apsides rotates at least 360^{o}

Mission

Data integrated into CINDI data system and delivered to NSSDC

SCIENCE REQUIREMENTS DOCUMENT

Inputs Level 1 Document Complete

Contents

- **Science Definition**
  - Baseline Science Objectives
  - Instruments
- **Mission Definition**
  - Organizations Involved
- **Programmatic Requirements**
  - Science and Mission Success
  - Ground System
  - Data Management
- **Cost Management and Scope Reduction**
  - Options and Impacts

Status

Delivered to NASA Headquarters and Explorer Office

INVESTIGATORS/RESPONSIBILITIES

Principal Investigator - R.A. Heelis

- Overall Direction of Investigation
- IVM and NWM Requirements
- Data Analysis and Distribution System
- Science and Technical Goals and Priorities

Co-Investigator - G.D. Earle

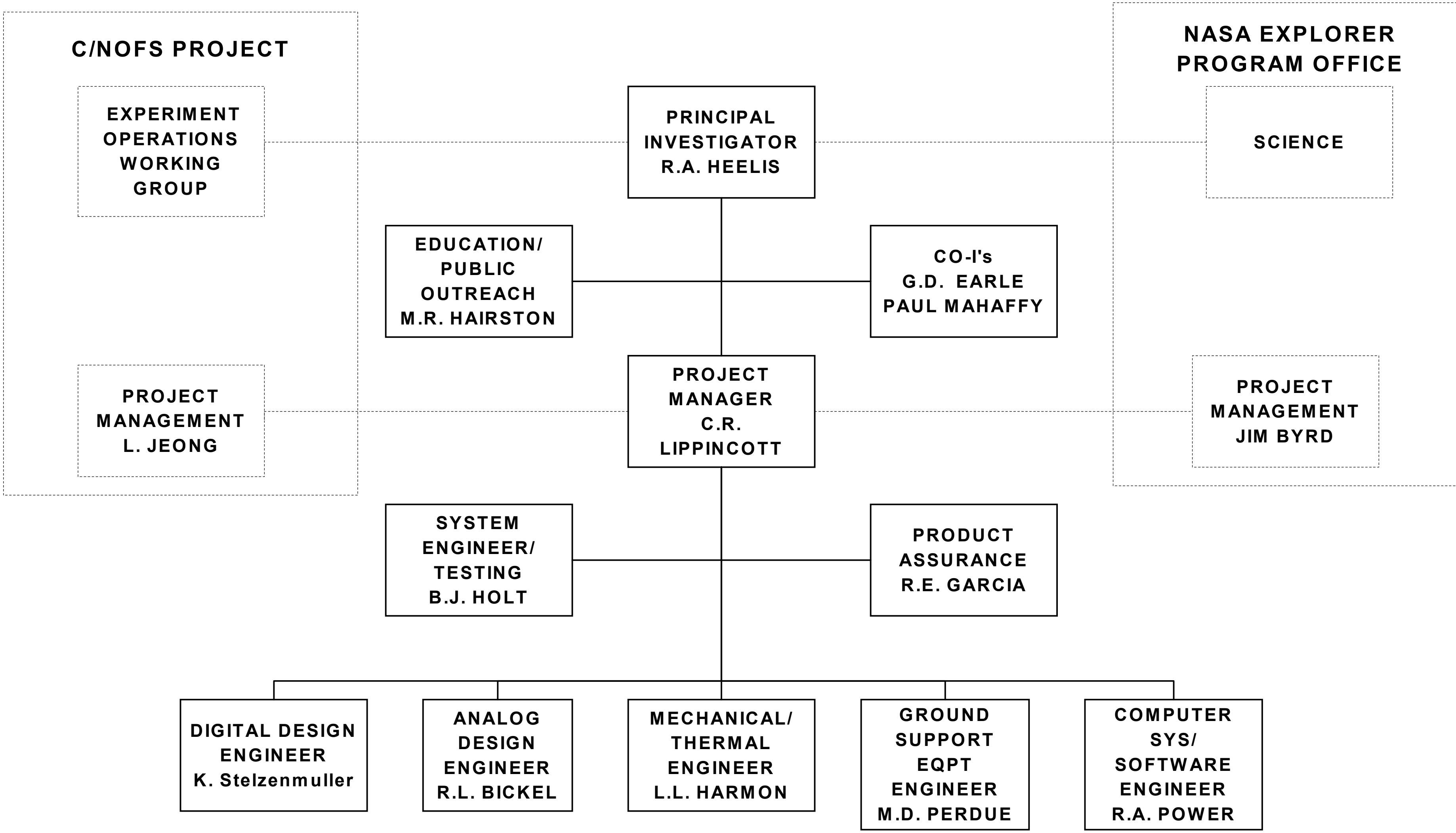
- NWM Instrument Design Features
- NWM Instrument Evaluation and Test
- Data Analysis and Interpretation

Co-Investigator - P.H.Mahaffy

- NWM optics design
- NWM ion source and detector performance
- Data Analysis and Interpretation

PROJECT MANAGEMENT - ORGANIZATION

PROJECT ORGANIZATION



RESPONSIBILITIES/ACCOUNTABILITY 1

Principal Investigator (PI)

- Responsible for successful performance of CINDI investigation throughout all phases and facets of project
    - Science Objectives
    - Instrumentation
    - Science Operations
    - Mission Planning Support
    - Data Analysis and Publication
    - Schedule and Cost
    - E/PO
- Ultimate decision making authority on allocation of resources in dispute
- Point of Contact for science matters
- Final decision maker on descope based on recommendations of PM and SE and approval of NASA and C/NOFS Project offices

RESPONSIBILITIES/ACCOUNTABILITY 2

Project Manager (PM)

- By delegation from the PI, PM is responsible for Implementation Phases of the project
- Manage day to day activities of the project
- Directly responsible for cost and schedule development and tracking
- Responsible for cost and schedule reserves with concurrence of PI
- Point of Contact for all management matters
- Responsible for implementation, control and tracking of risk management

RESPONSIBILITIES/ACCOUNTABILITY 3

System Engineer (SE)

- Responsible for overall instrument technical design
- Responsible for identification and control of all interfaces
- Allocation and tracking of mass, power and telemetry resources
- Lead technical team member in development, manufacture, test, integration and field support of instruments
- Responsible for Instrument Requirements Document
- Responsible for linkage between science objectives, instrument specifications, subsystem specification and instrument verification

RESPONSIBILITIES/ACCOUNTABILITY 4

Product Assurance Manager (PA)

- Responsible for product assurance performance consistent with C/NOFS project requirements and SMEX Safety, Reliability and Quality Assurance Requirements document and ISO 9000
- Implementation of CINDI Project Safety Plan requirements
- Responsible for CINDI Safety inputs to C/NOFS Project Safety Plan
- Reports to CINDI PM
    - Successful UTD approach used on past projects
    - PA regularly meets with PI and all CINDI engineers
    - Open communication with key CINDI personnel including PI
    - No traditional separate PA department

DECISION MAKING

- Technical decisions based on meeting science objectives with minimum risk and minimum resource usage
- Non-technical decisions based on minimizing schedule and cost risks while solving technical problems with judicious use of resources
- Technical decisions that do not affect interfaces, performance or resources concerning subsystems will be made by subsystem engineer
- Decisions that involve interface between subsystems and do not affect cost, schedule or performance will be made by SE
- Decisions that affect spacecraft interface will be made by consensus of SE and PM with PI informed
- Decisions to change technical resource allocations will be made by SE with PM and PI informed
- Decisions that affect instrument performance or science return will be made by the PI
- Decisions that affect schedule or cost are made by the PM with recommendations by SE - Release of cost or schedule reserves is by consensus with PI
- Decisions on descope will be made by PI with recommendations by PM & SE and approval by C/NOFS & NASA project offices

CONTRACT STATUS

- Preliminary negotiations complete on NASA/UTD Phase B/C/D/E contract
- SOW and Deliverables negotiated and completed
- NASA legal office performing last review
- UTD operating on Pre-award provision of Phase B/C/D/E contract
- Goal of Contract signed by both parties by 1 Sept 01

CONTACT INFORMATION

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PROJECT MANAGEMENT - SCHEDULE

SCHEDULE DEVELOPMENT

- Schedule developed and tracked in SureTrak by Primavera
- Developed from bottom with subsystem engineers and SE
- Generate task lists for each subsystem and contract requirements & deliverables
- WBS defined and formatted
- Identify task relational dependencies and durations
- Align to milestone constraints for major reviews, project requirements, and deliverables
- Add resources to tasks
- Level resources

PROJECT SCHEDULE/UPDATE

- Master schedule kept on CSS server
- Master schedule available to all disciplines as read only
- Subsystem engineers (SSE) also have discipline schedules distilled from master schedule
- SSEs report weekly on status
- Each SSE indicates work accomplished on discrete schedule task activity
- Status updates entered by PM office
- Changes or adjustments to schedule negotiated by PM and SE and/or SSE

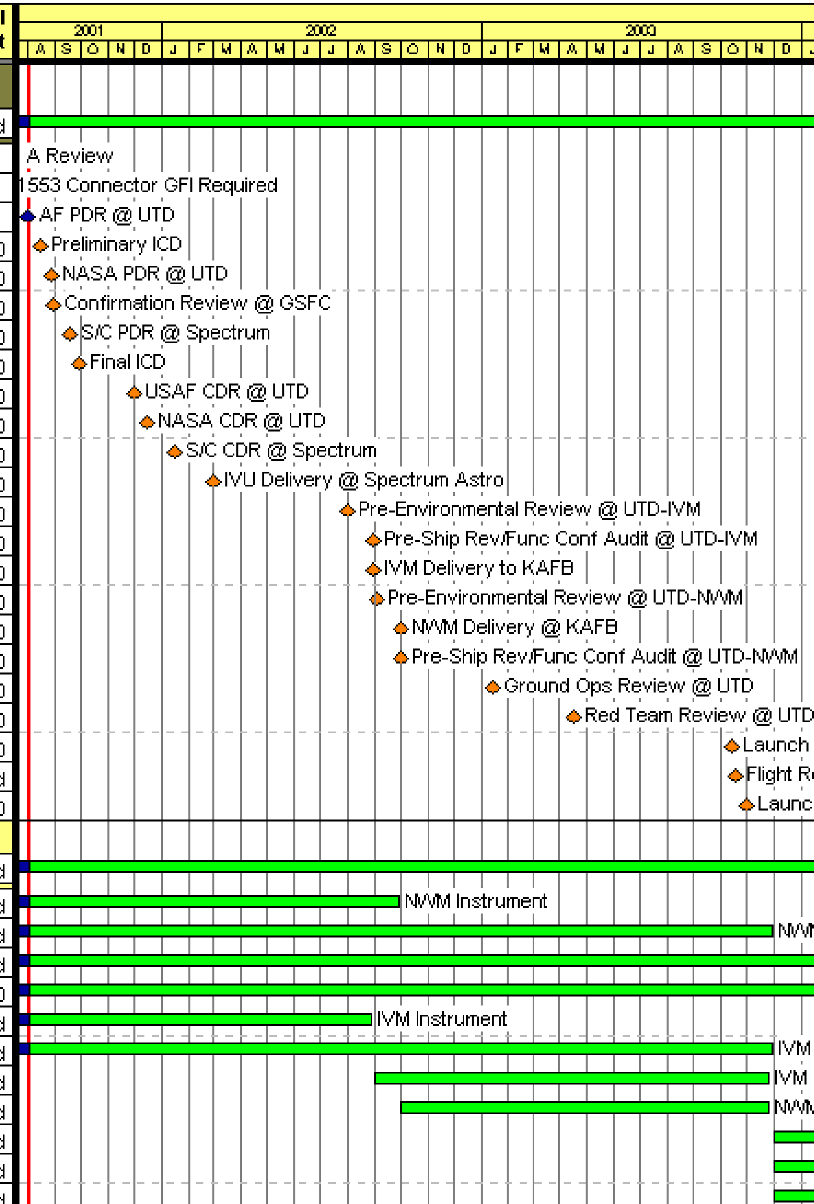
SCHEDULE TRACKING

- Total float for critical path to instrument delivery is tracked
- Keep critical path total float non-negative
- Identify and evaluate loss of float on non-critical path items
- Informal status reporting between monthly reports by telephone, fax, and e-mail
- Written status report monthly
- Approach enables us to manage early schedule to maintain schedule margin
- Able to spot problems early to apply solutions

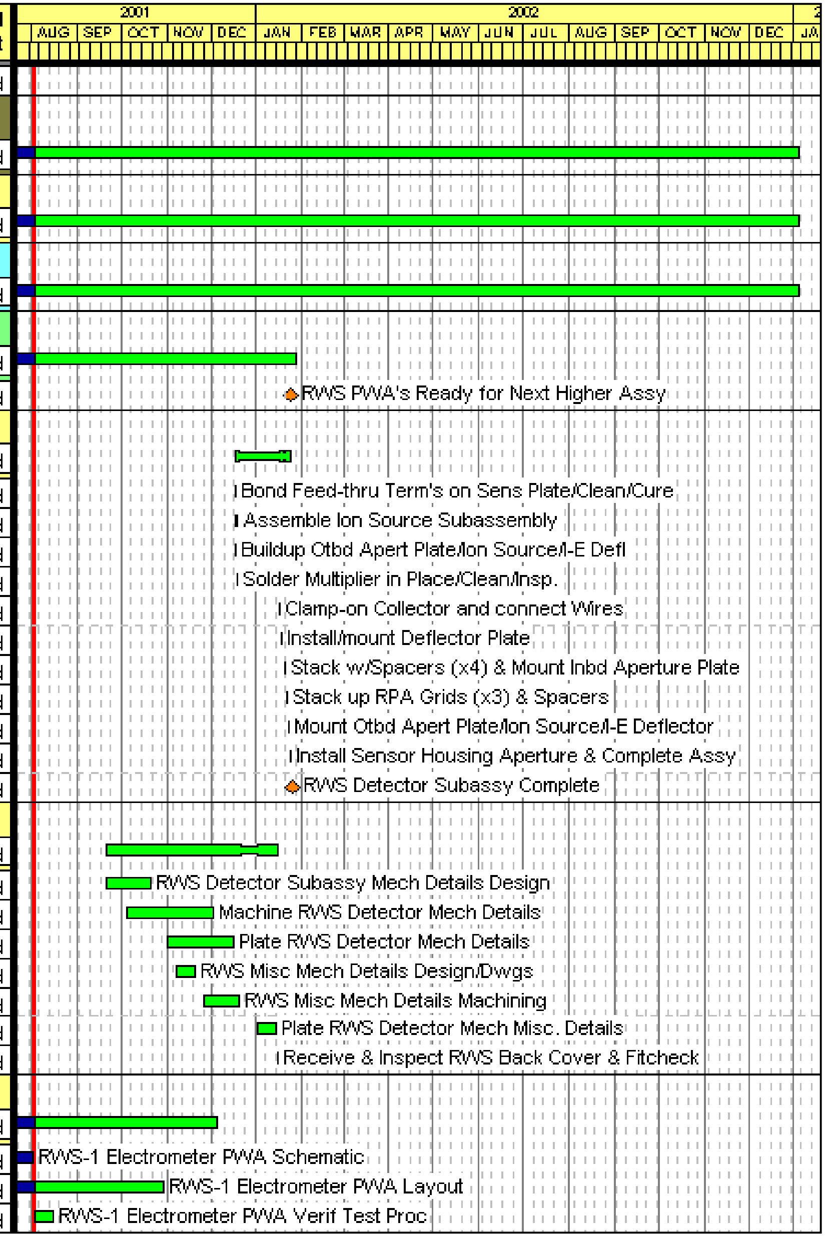
CURRENT SCHEDULE

- Have 22+ days float in critical path to delivery of each instrument
- Critical path
  - Last PWA in board series, then with its parts del, fab, assy and test
    - For IVM = Digital Controller Board (IVM-3)
    - For NWM = Digital Controller Board (EBOX-3)
  - Then series sensor/instrument assy & test, pack and ship
- Recent trends indicate no slippage
- Currently performing resource leveling

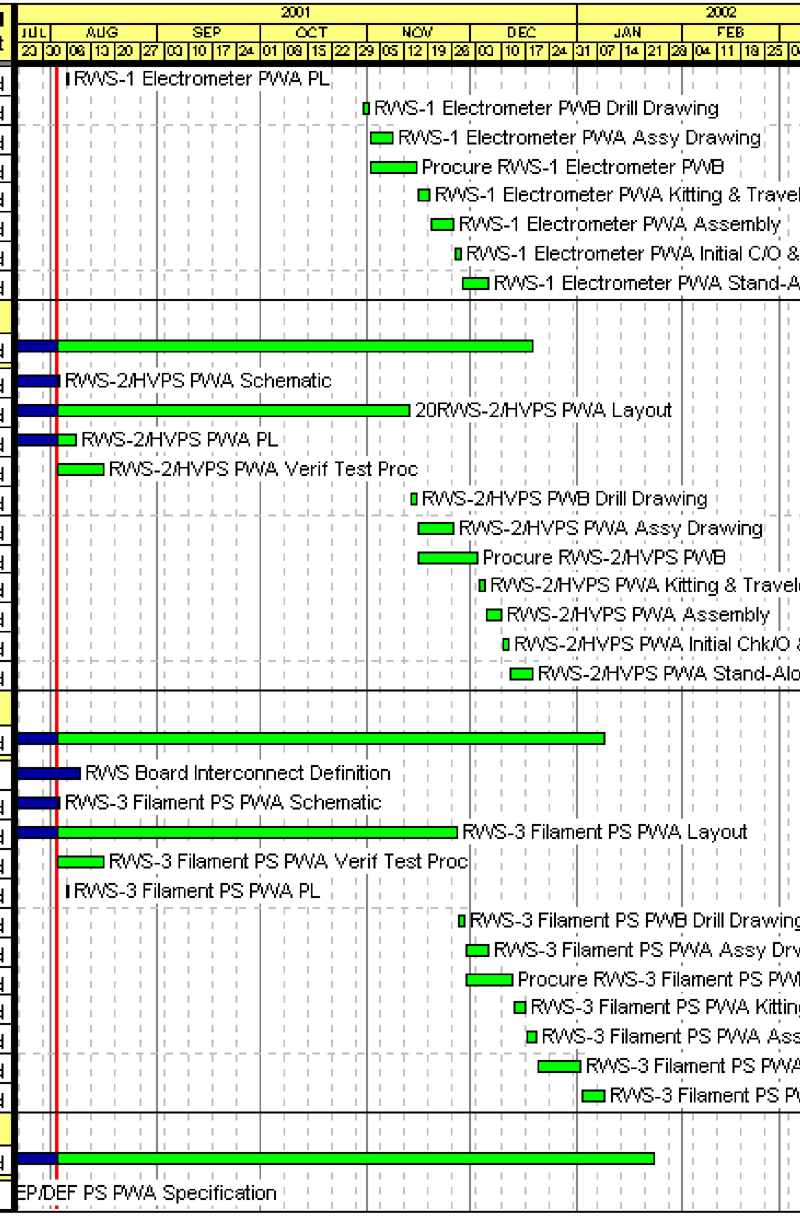
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
Milestones					
		1344	08 MAY 01	30 NOV 06	29d
CNA01410	Phase A Review	0		08 MAY 01	
CNIVU0005	1553 Connector GFI Required	0		05 JUL 01	
CNA01330	AF PDR @ UTD	0		31 JUL 01	
CNA01470	Preliminary ICD	0		14 AUG 01	0
CNA01510	NASA PDR @ UTD	0		28 AUG 01	0
CNA01320	Confirmation Review @ GSFC	0		30 AUG 01	0
CNA01420	S/C PDR @ Spectrum	0		18 SEP 01 *	0
CNA01500	Final ICD	0		27 SEP 01 *	0
CNA01343	USAF CDR @ UTD	0		29 NOV 01	0
CNA01340	NASA CDR @ UTD	0		14 DEC 01 *	0
CNA01430	S/C CDR @ Spectrum	0		15 JAN 02 *	0
CNIVU0041	IVU Delivery @ Spectrum Astro	0		01 MAR 02	0
CNIV1501	Pre-Environmental Review @ UTD-IVM	0		01 AUG 02	0
CNIV1504	Pre-Ship Rev/Func Conf Audit @ UTD-IVM	0		29 AUG 02	0
CNIV1579	IVM Delivery to KAFB	0		30 AUG 02	0
CNA01360	Pre-Environmental Review @ UTD-NWM	0		03 SEP 02 *	0
CNNW1522	NWM Delivery @ KAFB	0		30 SEP 02 *	0
CNA01380	Pre-Ship Rev/Func Conf Audit @ UTD-NWM	0		01 OCT 02	0
CNA01390	Ground Ops Review @ UTD	0		14 JAN 03 *	0
CNA01400	Red Team Review @ UTD	0		15 APR 03	0
CNA01453	Launch Readiness Review @ VAFB	0		14 OCT 03	0
CNA01450	Flight Readiness Review @ VAFB	0		17 OCT 03	43d
CNNW1870	Launch	0		31 OCT 03	0
Summary Schedule					
		1344	16 JUL 01	30 NOV 06	29d
CNA11020	NWM Instrument	289 *	16 JUL 01	30 SEP 02	1d
CNA11040	NWM Pre-Launch Data/Ops Prep	580 *	16 JUL 01	01 DEC 03	1d
CNA11070	Science Team Support	1344	16 JUL 01	30 NOV 06	29d
CNA11080	Education/Public Outreach (E/PO)	1344	16 JUL 01	30 NOV 06	0
CNA11100	IVM Instrument	269 *	16 JUL 01	30 AUG 02	1d
CNA11120	IVM Pre-Launch Data/Ops Prep	580 *	16 JUL 01	01 DEC 03	1d
CNA11150	IVM S/C Integration and Test	311	03 SEP 02	26 NOV 03	1d
CNA11030	NWM S/C Integration and Test	291	01 OCT 02	26 NOV 03	1d
CNA11050	NWM Data Red and Database MGT/Mission Ops	763	01 DEC 03	30 NOV 06	1d
CNA11060	NWM Science Analysis/Sci Ops	763	01 DEC 03	30 NOV 06	1d
CNA11130	IVM Data Red and Database MGT/Mission Ops	763	01 DEC 03 *	30 NOV 06	1d



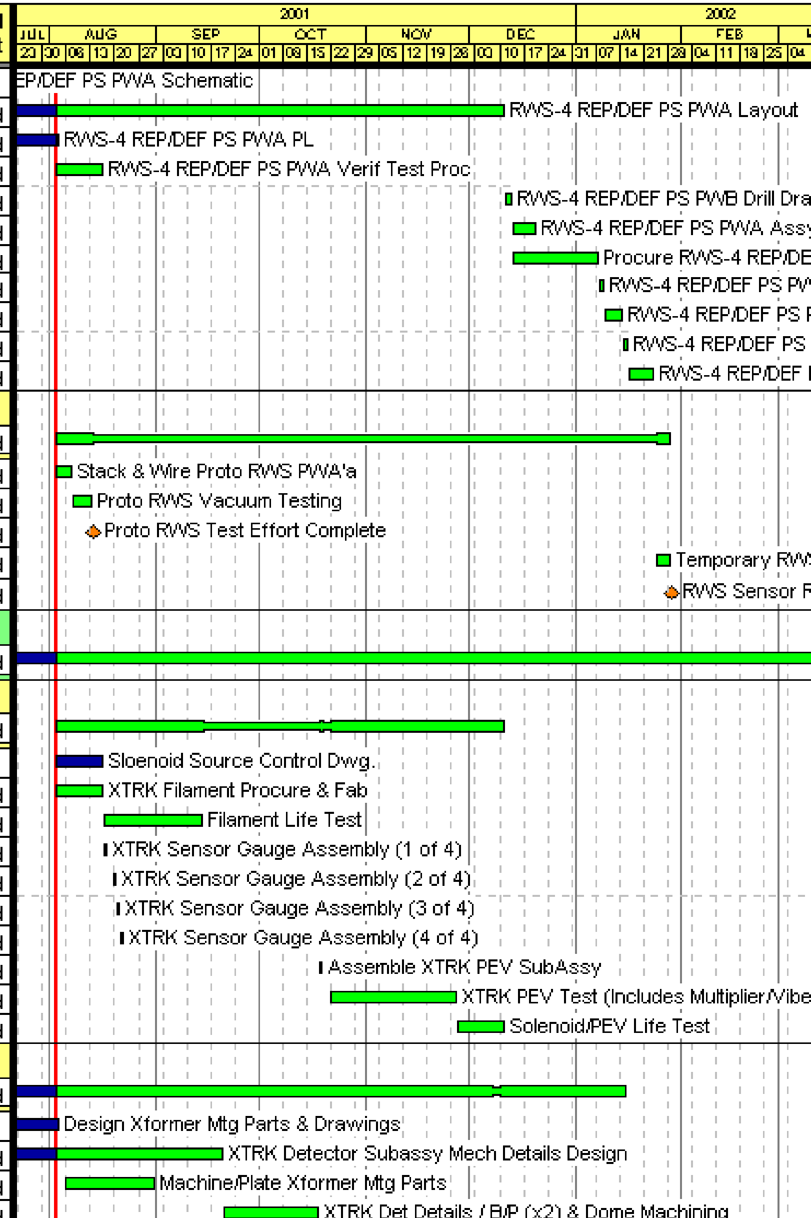
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNA11140	IVM Science Analysis/Sci Ops	763	01 DEC 03	30 NOV 06	1d
Neutral Wind Meter (NWM) Development					
		284	01 MAY 01	04 JAN 03	5d
NWM Instrument					
		284	01 MAY 01	04 JAN 03	5d
NWM Design & Fabrication					
		169	01 MAY 01	04 JAN 03	77d
Ram Wind Sensor (RWS)					
		117	26 JUN 01	28 JAN 02	58d
CNNW1320	RWS PWA's Ready for Next Higher Assy	0		23 JAN 02	59d
RWS Detector Subassembly					
		21	18 DEC 01	24 JAN 02	58d
CNNW2130	Bond Feed-thru Term's on Sens Plate/Clean/Cure	1	18 DEC 01	18 DEC 01	71d
CNNW2161	Assemble Ion Source Subassembly	2	18 DEC 01	19 DEC 01	75d
CNNW2173	Buildup Otbd Apert Plate/Ion Source/I-E Defl	1	18 DEC 01	18 DEC 01	76d
CNNW2132	Solder Multiplier in Place/Clean/Insp.	1	19 DEC 01	19 DEC 01	71d
CNNW2134	Clamp-on Collector and connect Wires	1	17 JAN 02	17 JAN 02	58d
CNNW2137	Install/mount Deflector Plate	1	18 JAN 02	18 JAN 02	58d
CNNW2140	Stack w/Spacers (x4) & Mount Inbd Aperture Plate	1	21 JAN 02	21 JAN 02	58d
CNNW2143	Stack up RPA Grids (x3) & Spacers	1	22 JAN 02	22 JAN 02	58d
CNNW2146	Mount Otbd Apert Plate/Ion Source/I-E Deflector	1	23 JAN 02	23 JAN 02	58d
CNNW2164	Install Sensor Housing Aperture & Complete Assy	1	24 JAN 02	24 JAN 02	58d
CNNW2167	RWS Detector Subassy Complete	0		24 JAN 02	58d
Housing & Mechanical Details					
		75	21 SEP 01	16 JAN 02	58d
CNNW2194	RWS Detector Subassy Mech Details Design	22	21 SEP 01	22 OCT 01	6d
CNNW2197	Machine RWS Detector Mech Details	40	05 OCT 01	03 DEC 01	71d
CNNW2200	Plate RWS Detector Mech Details	30	02 NOV 01	17 DEC 01	71d
CNNW2257	RWS Misc Mech Details Design/Dwgs	10	08 NOV 01	21 NOV 01	6d
CNNW2269	RWS Misc Mech Details Machining	20	26 NOV 01	21 DEC 01	58d
CNNW2266	Plate RWS Detector Mech Misc. Details	10	02 JAN 02	15 JAN 02	58d
CNNW2176	Receive & Inspect RWS Back Cover & Fitcheck	1	16 JAN 02	16 JAN 02	58d
RWS-1 / RWS Electrometer PWA					
		87	26 JUN 01	06 DEC 01	86d
CNNW2005	RWS-1 Electrometer PWA Schematic	1	26 JUN 01	03 AUG 01	158d
CNNW2008	RWS-1 Electrometer PWA Layout	62 *	26 JUN 01	30 OCT 01	86d
CNNW1466	RWS-1 Electrometer PWA Verif Test Proc	10	03 AUG 01	16 AUG 01	157d



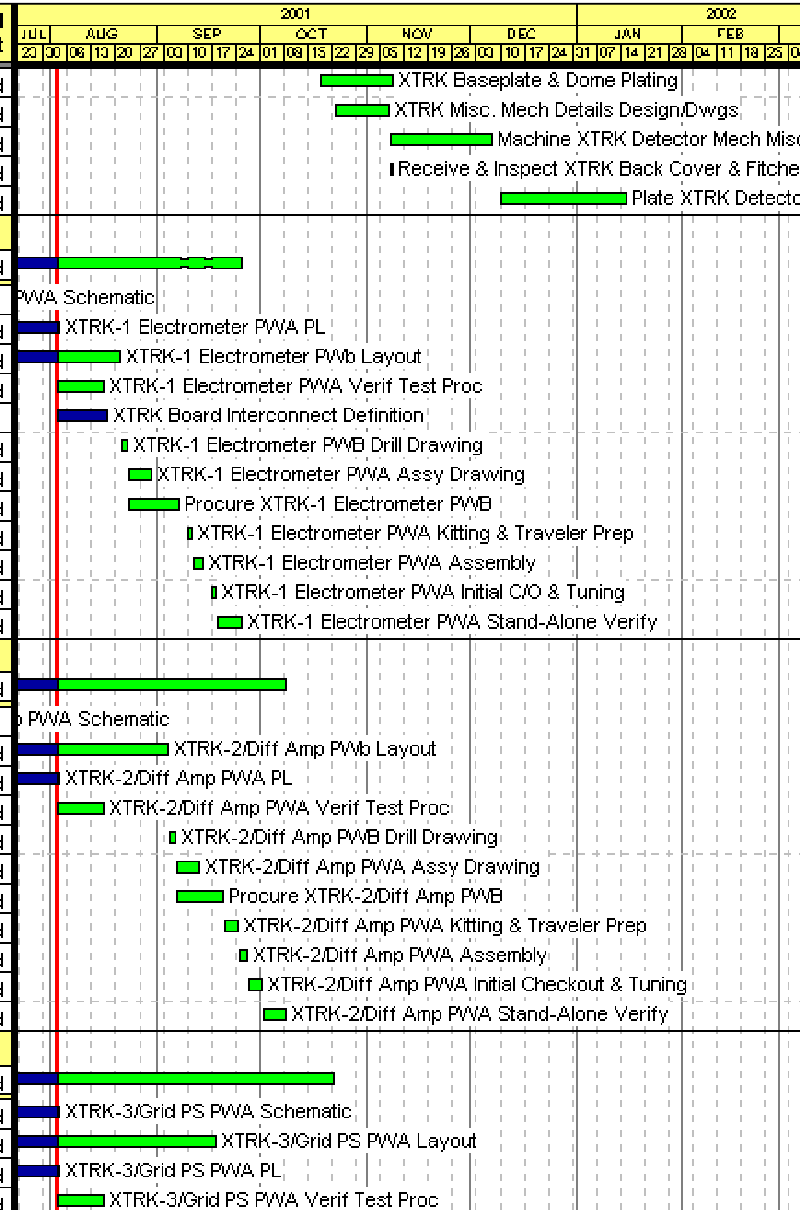
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNMW2014	RWS-1 Electrometer PWA PL	1	06 AUG 01	06 AUG 01	158d
CNMW2010	RWS-1 Electrometer PWB Drill Drawing	2	31 OCT 01	01 NOV 01	86d
CNMW2012	RWS-1 Electrometer PWA Assy Drawing	5	02 NOV 01	08 NOV 01	93d
CNMW2015	Procure RWS-1 Electrometer PWB	10	02 NOV 01	15 NOV 01	86d
CNMW2021	RWS-1 Electrometer PWA Kitting & Traveler Prep	2	16 NOV 01	19 NOV 01	86d
CNMW2024	RWS-1 Electrometer PWA Assembly	3	20 NOV 01	26 NOV 01	86d
CNMW2027	RWS-1 Electrometer PWA Initial C/O & Tuning	2	27 NOV 01	28 NOV 01	86d
CNMW2030	RWS-1 Electrometer PWA Stand-Alone Verify	6	29 NOV 01	06 DEC 01	86d
RWS-2 / HVPS PWA					
		96	26 JUN 01	19 DEC 01	77d
CNMW2040	RWS-2/HVPS PWA Schematic	1	26 JUN 01	03 AUG 01	148d
CNMW2042	20RWS-2/HVPS PWA Layout	72 *	26 JUN 01	13 NOV 01	77d
CNMW2048	RWS-2/HVPS PWA PL	4	26 JUN 01	08 AUG 01	157d
CNMW1469	RWS-2/HVPS PWA Verif Test Proc	10	03 AUG 01	16 AUG 01	158d
CNMW2044	RWS-2/HVPS PWB Drill Drawing	2	14 NOV 01	15 NOV 01	77d
CNMW2046	RWS-2/HVPS PWA Assy Drawing	5	16 NOV 01	26 NOV 01	84d
CNMW2050	Procure RWS-2/HVPS PWB	10	16 NOV 01	03 DEC 01	77d
CNMW2054	RWS-2/HVPS PWA Kitting & Traveler Prep	2	04 DEC 01	05 DEC 01	77d
CNMW2056	RWS-2/HVPS PWA Assembly	3	06 DEC 01	10 DEC 01	77d
CNMW2058	RWS-2/HVPS PWA Initial Chk/O & Tuning	2	11 DEC 01	12 DEC 01	77d
CNMW2060	RWS-2/HVPS PWA Stand-Alone Verify	5	13 DEC 01	19 DEC 01	77d
RWS-3 / Filament Power Supply PWA					
		104	26 JUN 01	09 JAN 02	69d
CNMW2068/	RWS Board Interconnect Definition	0	26 JUN 01	09 AUG 01	
CNMW2070	RWS-3 Filament PS PWA Schematic	1	26 JUN 01	03 AUG 01	159d
CNMW2072	RWS-3 Filament PS PWA Layout	80 *	26 JUN 01	27 NOV 01	69d
CNMW1472	RWS-3 Filament PS PWA Verif Test Proc	10	03 AUG 01	16 AUG 01	158d
CNMW2078	RWS-3 Filament PS PWA PL	1	06 AUG 01	06 AUG 01	159d
CNMW2074	RWS-3 Filament PS PWB Drill Drawing	2	28 NOV 01	29 NOV 01	69d
CNMW2076	RWS-3 Filament PS PWA Assy Drwg	5	30 NOV 01	06 DEC 01	76d
CNMW2080	Procure RWS-3 Filament PS PWB	10	30 NOV 01	13 DEC 01	69d
CNMW2084	RWS-3 Filament PS PWA Kitting & Traveler Prep	2	14 DEC 01	17 DEC 01	69d
CNMW2086	RWS-3 Filament PS PWA Assembly	3	18 DEC 01	20 DEC 01	69d
CNMW2088	RWS-3 Filament PS PWA Initial Chk/O & Tuning	2	21 DEC 01	02 JAN 02	69d
CNMW2090	RWS-3 Filament PS PWA Stand-Alone Verify	5	03 JAN 02	09 JAN 02	69d
RWS-4 / REP/DEF Power Supply PWA					
		114	26 JUN 01	23 JAN 02	59d
CNMW2096	RWS-4 REP/DEF PS PWA Specification	0	26 JUN 01	26 JUN 01	



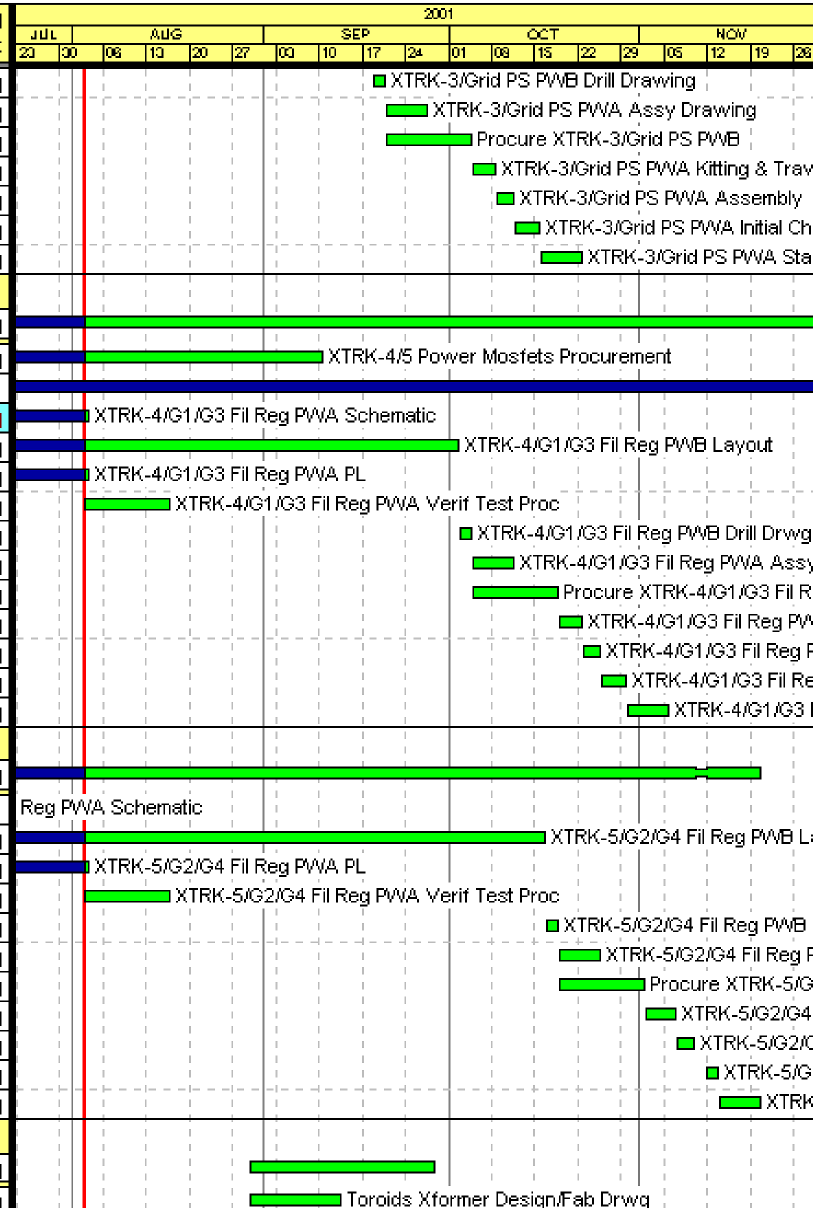
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNNW2098	RWS-4 REP/DEF PS PWA Schematic	0	26 JUN 01	26 JUN 01	
CNNW2100	RWS-4 REP/DEF PS PWA Layout	90 *	26 JUN 01	11 DEC 01	59d
CNNW2106	RWS-4 REP/DEF PS PWA PL	1	26 JUN 01	03 AUG 01	160d
CNNW1475	RWS-4 REP/DEF PS PWA Verif Test Proc	10	03 AUG 01	16 AUG 01	158d
CNNW2102	RWS-4 REP/DEF PS PWB Drill Drawing	2	12 DEC 01	13 DEC 01	59d
CNNW2104	RWS-4 REP/DEF PS PWA Assy Drwg	5	14 DEC 01	20 DEC 01	66d
CNNW2108	Procure RWS-4 REP/DEF PS PWB	10	14 DEC 01	07 JAN 02	59d
CNNW2112	RWS-4 REP/DEF PS PWA Kitting & Traveler Prep	2	08 JAN 02	09 JAN 02	59d
CNNW2114	RWS-4 REP/DEF PS PWA Assembly	3	10 JAN 02	14 JAN 02	59d
CNNW2116	RWS-4 REP/DEF PS PWA Initial C/O Tuning	2	15 JAN 02	16 JAN 02	59d
CNNW2118	RWS-4 REP/DEF PS PWA Stand-Alone Verify	5	17 JAN 02	23 JAN 02	59d
RWS Sensor Assembly & Test					
		117	03 AUG 01	28 JAN 02	58d
CNNWP005	Stack & Wire Proto RWS PWA'a	3	03 AUG 01	07 AUG 01	14d
CNNWP008	Proto RWS Vacuum Testing	4	08 AUG 01	13 AUG 01	14d
CNNWP011	Proto RWS Test Effort Complete	0		13 AUG 01	14d
CNNW2170	Temporary RWS Buildup w/PWAs	2	25 JAN 02	28 JAN 02	58d
CNNW2191	RWS Sensor Ready for NWM Integration	0		28 JAN 02	58d
Cross-Track Wind Sensor (XTRK WS)					
		113	14 MAY 01	04 JAN 03	62d
XTRK Detector Subassembly					
		90	03 AUG 01	11 DEC 01	80d
CNNW1269	Sloenoid Source Control Dwg.	0	03 AUG 01	16 AUG 01	
CNNW2230	XTRK Filament Procure & Fab	10	03 AUG 01	16 AUG 01	10d
CNNW1340	Filament Life Test	20	17 AUG 01	14 SEP 01	10d
CNNW2212	XTRK Sensor Gauge Assembly (1 of 4)	1	17 AUG 01	17 AUG 01	45d
CNNW2215	XTRK Sensor Gauge Assembly (2 of 4)	1	20 AUG 01	20 AUG 01	45d
CNNW2218	XTRK Sensor Gauge Assembly (3 of 4)	1	21 AUG 01	21 AUG 01	156d
CNNW2221	XTRK Sensor Gauge Assembly (4 of 4)	1	22 AUG 01	22 AUG 01	156d
CNNW2227	Assemble XTRK PEV SubAssy	1	19 OCT 01	19 OCT 01	3d
CNNW1330	XTRK PEV Test (Includes Multiplier/Vibe Test)	25	22 OCT 01	27 NOV 01	3d
CNNW2419	Solenoid/PEV Life Test	10	28 NOV 01	11 DEC 01	3d
Housing & Mechanical Details					
		108	01 JUN 01	15 JAN 02	64d
CNNW1360	Design Xformer Mtg Parts & Drawings	0 *	01 JUN 01	03 AUG 01	
CNNW2204	XTRK Detector Subassy Mech Details Design	34 *	01 JUN 01	20 SEP 01	3d
CNNW2224	Machine/Plate Xformer Mtg Parts	20	06 AUG 01	31 AUG 01	141d
CNNW2260	XTRK Det Details / B/P (x2) & Dome Machining	20	21 SEP 01	18 OCT 01	3d



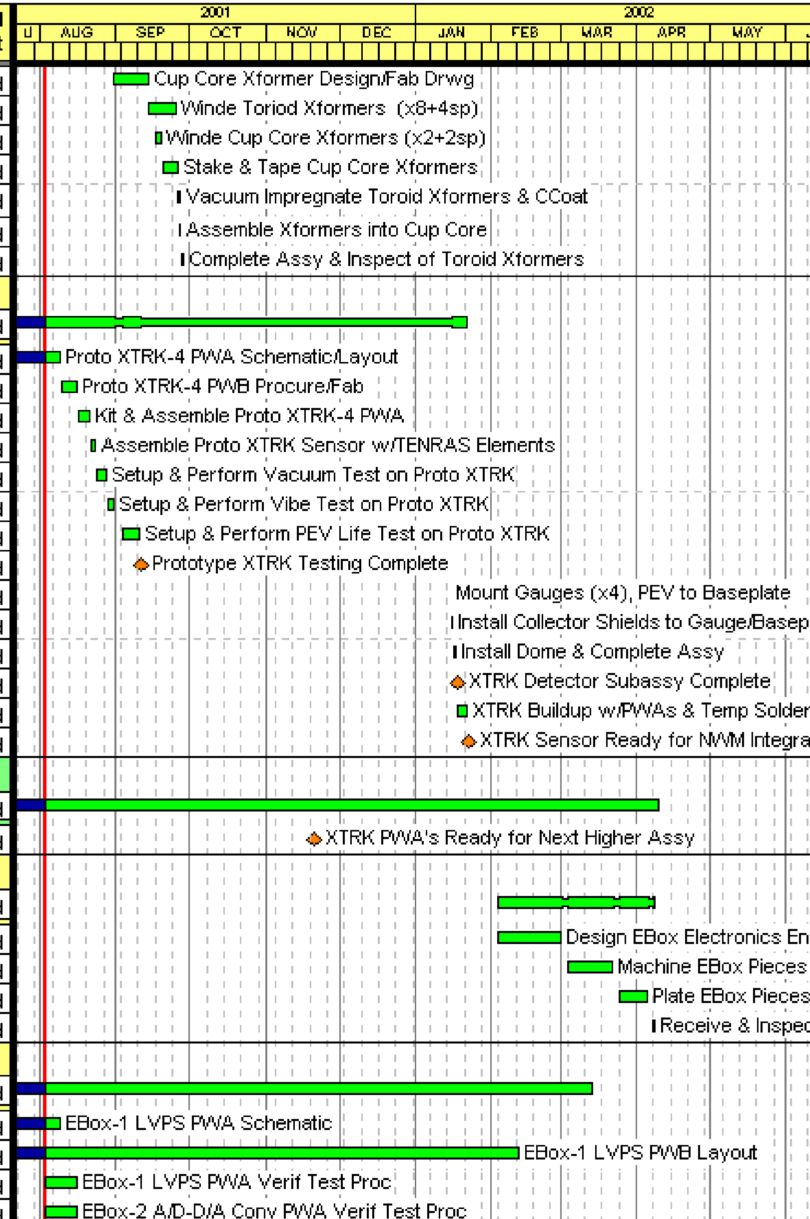
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNNW2263	XTRK Baseplate & Dome Plating	15	19 OCT 01	08 NOV 01	101d
CNNW2203	XTRK Misc. Mech Details Design/Dwgs	12	23 OCT 01	07 NOV 01	6d
CNNW2206	Machine XTRK Detector Mech Misc. Details	20	08 NOV 01	07 DEC 01	62d
CNNW2461	Receive & Inspect XTRK Back Cover & Fitcheck	1	08 NOV 01	08 NOV 01	103d
CNNW2209	Plate XTRK Detector Mech Details	20	10 DEC 01	15 JAN 02	62d
XTRK-1 / Cross-Track Electrometers PWA					
		37	14 MAY 01	25 SEP 01	135d
CNNW2272	XTRK-1 Electrometer PWA Schematic	0	14 MAY 01	25 MAY 01	
CNNW2284	XTRK-1 Electrometer PWA PL	1	23 MAY 01	03 AUG 01	159d
CNNW2275	XTRK-1 Electrometer PWb Layout	13 *	28 MAY 01	21 AUG 01	135d
CNNW1451	XTRK-1 Electrometer PWA Verif Test Proc	10	03 AUG 01	16 AUG 01	157d
CNNW2273	XTRK Board Interconnect Definition	0	03 AUG 01	17 AUG 01	
CNNW2278	XTRK-1 Electrometer PWB Drill Drawing	2	22 AUG 01	23 AUG 01	135d
CNNW2281	XTRK-1 Electrometer PWA Assy Drawing	5	24 AUG 01	30 AUG 01	140d
CNNW2287	Procure XTRK-1 Electrometer PWB	10	24 AUG 01	07 SEP 01	135d
CNNW2293	XTRK-1 Electrometer PWA Kitting & Traveler Prep	2	10 SEP 01	11 SEP 01	135d
CNNW2296	XTRK-1 Electrometer PWA Assembly	3	12 SEP 01	14 SEP 01	135d
CNNW2299	XTRK-1 Electrometer PWA Initial C/O & Tuning	2	17 SEP 01	18 SEP 01	135d
CNNW2302	XTRK-1 Electrometer PWA Stand-Alone Verify	5	19 SEP 01	25 SEP 01	135d
XTRK-2 / Difference Amplifiers PWA					
		46	28 MAY 01	08 OCT 01	126d
CNNW2308	XTRK-2/Diff Amp PWA Schematic	0	28 MAY 01	08 JUN 01	
CNNW2311	XTRK-2/Diff Amp PWb Layout	22 *	11 JUN 01	04 SEP 01	126d
CNNW2320	XTRK-2/Diff Amp PWA PL	1	26 JUN 01	03 AUG 01	159d
CNNW1454	XTRK-2/Diff Amp PWA Verif Test Proc	10	03 AUG 01	16 AUG 01	157d
CNNW2314	XTRK-2/Diff Amp PWB Drill Drawing	2	05 SEP 01	06 SEP 01	126d
CNNW2317	XTRK-2/Diff Amp PWA Assy Drawing	5	07 SEP 01	13 SEP 01	131d
CNNW2323	Procure XTRK-2/Diff Amp PWB	10	07 SEP 01	20 SEP 01	126d
CNNW2329	XTRK-2/Diff Amp PWA Kitting & Traveler Prep	2	21 SEP 01	24 SEP 01	126d
CNNW2332	XTRK-2/Diff Amp PWA Assembly	3	25 SEP 01	27 SEP 01	126d
CNNW2335	XTRK-2/Diff Amp PWA Initial Checkout & Tuning	2	28 SEP 01	01 OCT 01	126d
CNNW2338	XTRK-2/Diff Amp PWA Stand-Alone Verify	5	02 OCT 01	08 OCT 01	126d
XTRK-3 / Grid Power Supply PWA					
		56	26 JUN 01	22 OCT 01	116d
CNNW2344	XTRK-3/Grid PS PWA Schematic	1	26 JUN 01	03 AUG 01	141d
CNNW2347	XTRK-3/Grid PS PWA Layout	32 *	26 JUN 01	18 SEP 01	116d
CNNW2356	XTRK-3/Grid PS PWA PL	1	26 JUN 01	03 AUG 01	159d
CNNW1457	XTRK-3/Grid PS PWA Verif Test Proc	10	03 AUG 01	16 AUG 01	157d



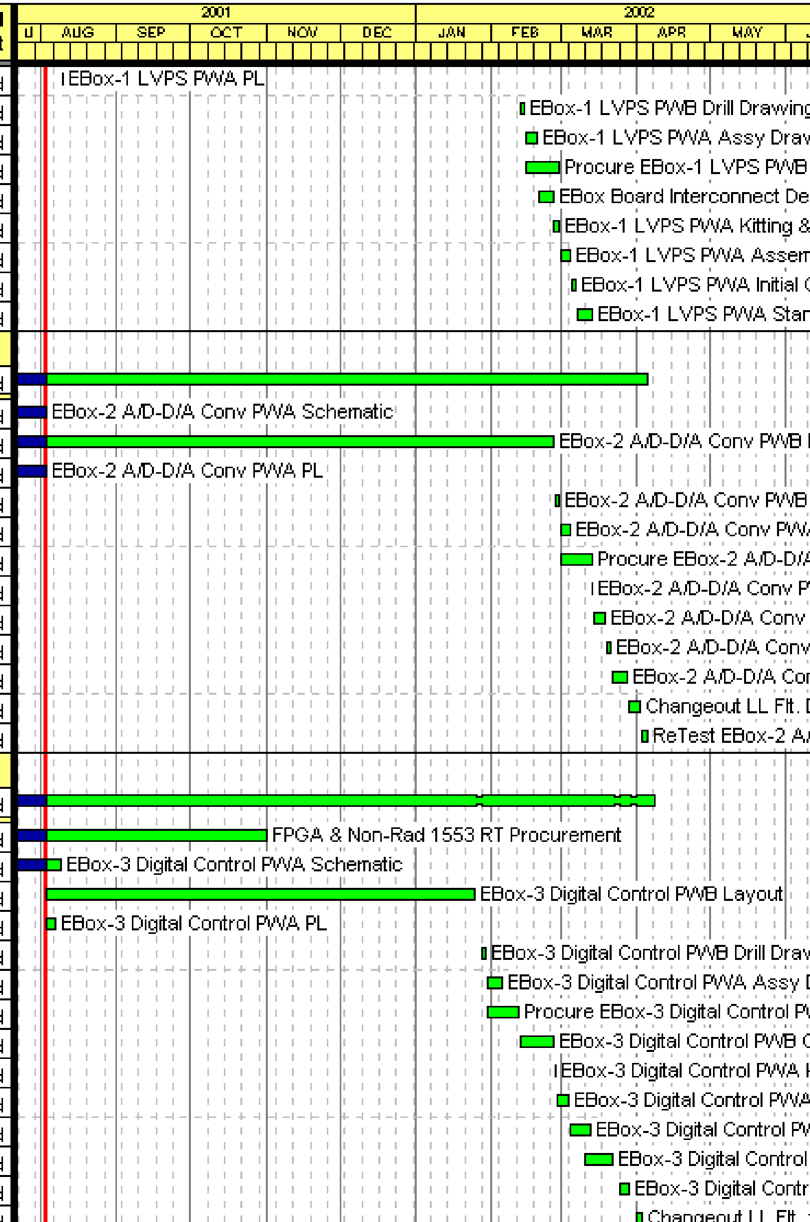
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNMW2350	XTRK-3/Grid PS PWB Drill Drawing	2	19 SEP 01	20 SEP 01	116d
CNMW2353	XTRK-3/Grid PS PWA Assy Drawing	5	21 SEP 01	27 SEP 01	121d
CNMW2359	Procure XTRK-3/Grid PS PWB	10	21 SEP 01	04 OCT 01	116d
CNMW2365	XTRK-3/Grid PS PWA Kitting & Traveler Prep	2	05 OCT 01	08 OCT 01	116d
CNMW2368	XTRK-3/Grid PS PWA Assembly	3	09 OCT 01	11 OCT 01	116d
CNMW2371	XTRK-3/Grid PS PWA Initial Checkout & Tuning	2	12 OCT 01	15 OCT 01	116d
CNMW2374	XTRK-3/Grid PS PWA Stand-Alone Verify	5	16 OCT 01	22 OCT 01	116d
XTRK-4 / G1/G3 Filament Regulators PWA					
		66	26 JUN 01	04 JAN 03	106d
CNMW2258	XTRK-4/5 Power Mosfets Procurement	26 *	26 JUN 01	10 SEP 01	139d
CNMW2377	XTRK-4/G1/G3 Fil Reg PWA Specification	0	26 JUN 01	04 JAN 03	
CNMW2380	XTRK-4/G1/G3 Fil Reg PWA Schematic	1	26 JUN 01	03 AUG 01	145d
CNMW2383	XTRK-4/G1/G3 Fil Reg PWB Layout	42 *	26 JUN 01	02 OCT 01	106d
CNMW2392	XTRK-4/G1/G3 Fil Reg PWA PL	1	26 JUN 01	03 AUG 01	159d
CNMW1463	XTRK-4/G1/G3 Fil Reg PWA Verif Test Proc	10	03 AUG 01	16 AUG 01	157d
CNMW2386	XTRK-4/G1/G3 Fil Reg PWB Drill Drwg	2	03 OCT 01	04 OCT 01	106d
CNMW2389	XTRK-4/G1/G3 Fil Reg PWA Assy Drwg	5	05 OCT 01	11 OCT 01	111d
CNMW2395	Procure XTRK-4/G1/G3 Fil Reg PWB	10	05 OCT 01	18 OCT 01	106d
CNMW2401	XTRK-4/G1/G3 Fil Reg PWA Kitting & Traveler Prep	2	19 OCT 01	22 OCT 01	106d
CNMW2404	XTRK-4/G1/G3 Fil Reg PWA Assembly	3	23 OCT 01	25 OCT 01	106d
CNMW2407	XTRK-4/G1/G3 Fil Reg PWA Initial C/O & Tuning	2	26 OCT 01	29 OCT 01	106d
CNMW2410	XTRK-4/G1/G3 Fil Reg PWA Stand-Alone Verify	5	30 OCT 01	05 NOV 01	106d
XTRK-5 / G2/G4 Filament Regulators PWA					
		77	26 JUN 01	20 NOV 01	95d
CNMW2487	XTRK-5/G2/G4 Fil Reg PWA Schematic	0	26 JUN 01	26 JUN 01	
CNMW2490	XTRK-5/G2/G4 Fil Reg PWB Layout	52 *	26 JUN 01	16 OCT 01	95d
CNMW2499	XTRK-5/G2/G4 Fil Reg PWA PL	1	26 JUN 01	03 AUG 01	158d
CNMW1487	XTRK-5/G2/G4 Fil Reg PWA Verif Test Proc	10	03 AUG 01	16 AUG 01	157d
CNMW2493	XTRK-5/G2/G4 Fil Reg PWB Drill Drawing	2	17 OCT 01	18 OCT 01	95d
CNMW2496	XTRK-5/G2/G4 Fil Reg PWA Assy Drwg	5	19 OCT 01	25 OCT 01	100d
CNMW2502	Procure XTRK-5/G2/G4 Fil Reg PWB	10	19 OCT 01	01 NOV 01	95d
CNMW2508	XTRK-5/G2/G4 Fil Reg PWA Kitting & Traveler Prep	3	02 NOV 01	06 NOV 01	95d
CNMW2511	XTRK-5/G2/G4 Fil Reg PWA Assembly	3	07 NOV 01	09 NOV 01	95d
CNMW2514	XTRK-5/G2/G4 Fil Reg PWA Initial C/O & Tuning	2	12 NOV 01	13 NOV 01	95d
CNMW2517	XTRK-5/G2/G4 Fil Reg PWA Stand-Alone Verify	5	14 NOV 01	20 NOV 01	95d
Transformer Subassembly					
		21	30 AUG 01	28 SEP 01	122d
CNMW1519	Toroids Xformer Design/Fab Drwg	10	30 AUG 01	13 SEP 01	122d



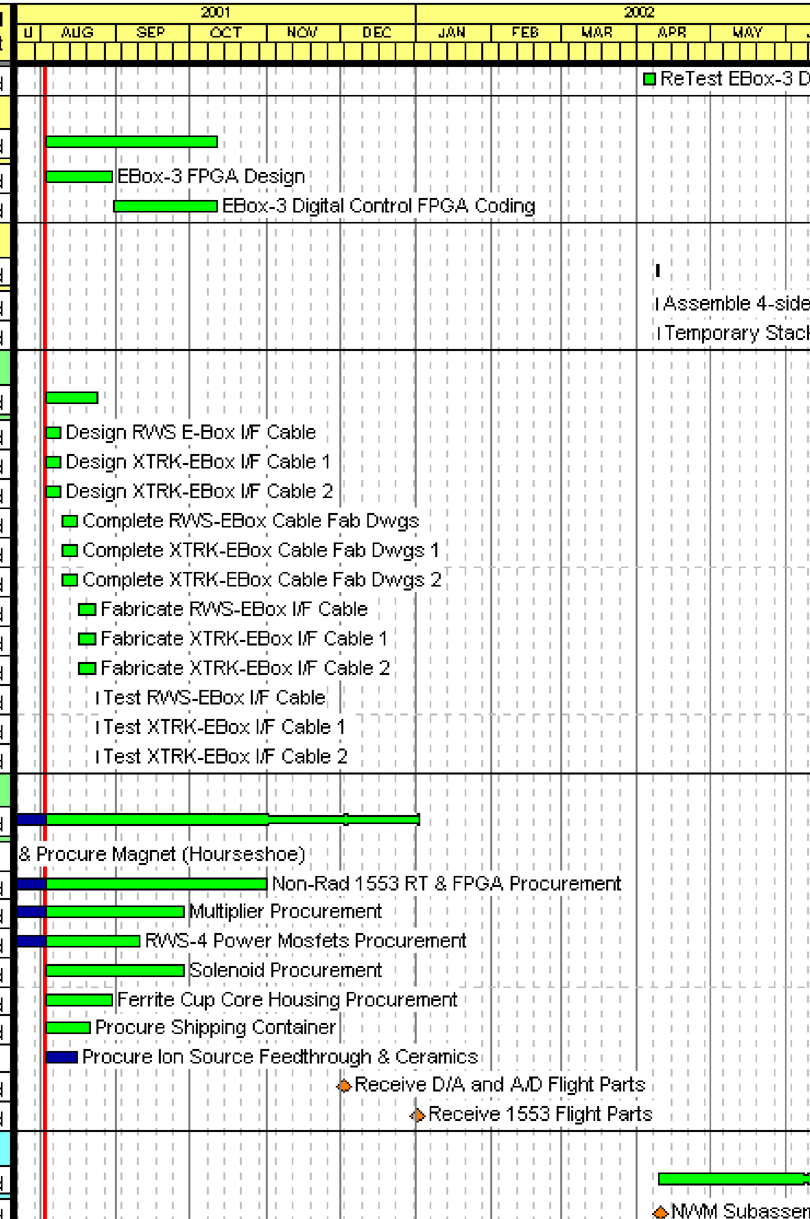
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNMW1516	Cup Core Xformer Design/Fab Drwg	10	31 AUG 01	14 SEP 01	123d
CNMW1300	Winde Toriod Xformers (x8+4sp)	8	14 SEP 01	25 SEP 01	122d
CNMW1306	Winde Cup Core Xformers (x2+2sp)	3	17 SEP 01	19 SEP 01	123d
CNMW1309	Stake & Tape Cup Core Xformers	5	20 SEP 01	26 SEP 01	123d
CNMW1321	Vacuum Impregnate Toroid Xformers & CCoat	2	26 SEP 01	27 SEP 01	122d
CNMW1315	Assemble Xformers into Cup Core	1	27 SEP 01	27 SEP 01	123d
CNMW1303	Complete Assy & Inspect of Toroid Xformers	1	28 SEP 01	28 SEP 01	122d
XTRK Assembly & Test					
		113	06 JUL 01	22 JAN 02	62d
CNMWP014	Proto XTRK-4 PWA Schematic/Layout	5	06 JUL 01	09 AUG 01	4d
CNMWP017	Proto XTRK-4 PWB Procure/Fab	5	10 AUG 01	16 AUG 01	4d
CNMWP020	Kit & Assemble Proto XTRK-4 PWA	3	17 AUG 01	21 AUG 01	4d
CNMWP023	Assemble Proto XTRK Sensor w/TENRAS Elements	2	22 AUG 01	23 AUG 01	4d
CNMWP032	Setup & Perform Vacuum Test on Proto XTRK	3	24 AUG 01	28 AUG 01	4d
CNMWP026	Setup & Perform Vibe Test on Proto XTRK	3	29 AUG 01	31 AUG 01	4d
CNMWP029	Setup & Perform PEV Life Test on Proto XTRK	5	04 SEP 01	10 SEP 01	4d
CNMWP035	Prototype XTRK Testing Complete	0		10 SEP 01	4d
CNMW2413	Mount Gauges (x4), PEV to Baseplate	0	16 JAN 02	15 JAN 02	62d
CNMW2416	Install Collector Shields to Gauge/Baseplate	1	16 JAN 02	16 JAN 02	62d
CNMW2449	Install Dome & Complete Assy	1	17 JAN 02	17 JAN 02	62d
CNMW2452	XTRK Detector Subassy Complete	0		17 JAN 02	62d
CNMW2455	XTRK Buildup w/PWAs & Temp Solder Connections	3	18 JAN 02	22 JAN 02	62d
CNMW2476	XTRK Sensor Ready for NWM Integration	0		22 JAN 02	62d
NWM Electronics (EBOX)					
		169	26 JUN 01	10 APR 02	6d
CNMW2251	XTRK PWA's Ready for Next Higher Assy	0		20 NOV 01	95d
Enclosure & Misc. Details					
		46	04 FEB 02	08 APR 02	6d
CNMW2690	Design EBox Electronics Enclosure	20	04 FEB 02	01 MAR 02	6d
CNMW2687	Machine EBox Pieces (x6) @ Vendor	15	04 MAR 02	22 MAR 02	6d
CNMW2681	Plate EBox Pieces (x6) @ Vendor	10	25 MAR 02	05 APR 02	6d
CNMW2684	Receive & Inspect EBox Pieces	1	08 APR 02	08 APR 02	6d
EBox-1 / LVPS PWA					
		150	26 JUN 01	14 MAR 02	24d
CNMW2504	EBox-1 LVPS PWA Schematic	5	26 JUN 01	09 AUG 01	155d
CNMW2507	EBox-1 LVPS PWB Layout	128 *	26 JUN 01	12 FEB 02	24d
CNMW1478	EBox-1 LVPS PWA Verif Test Proc	10	03 AUG 01	16 AUG 01	159d
CNMW1481	EBox-2 A/D-D/A Conv PWA Verif Test Proc	10	03 AUG 01	16 AUG 01	153d



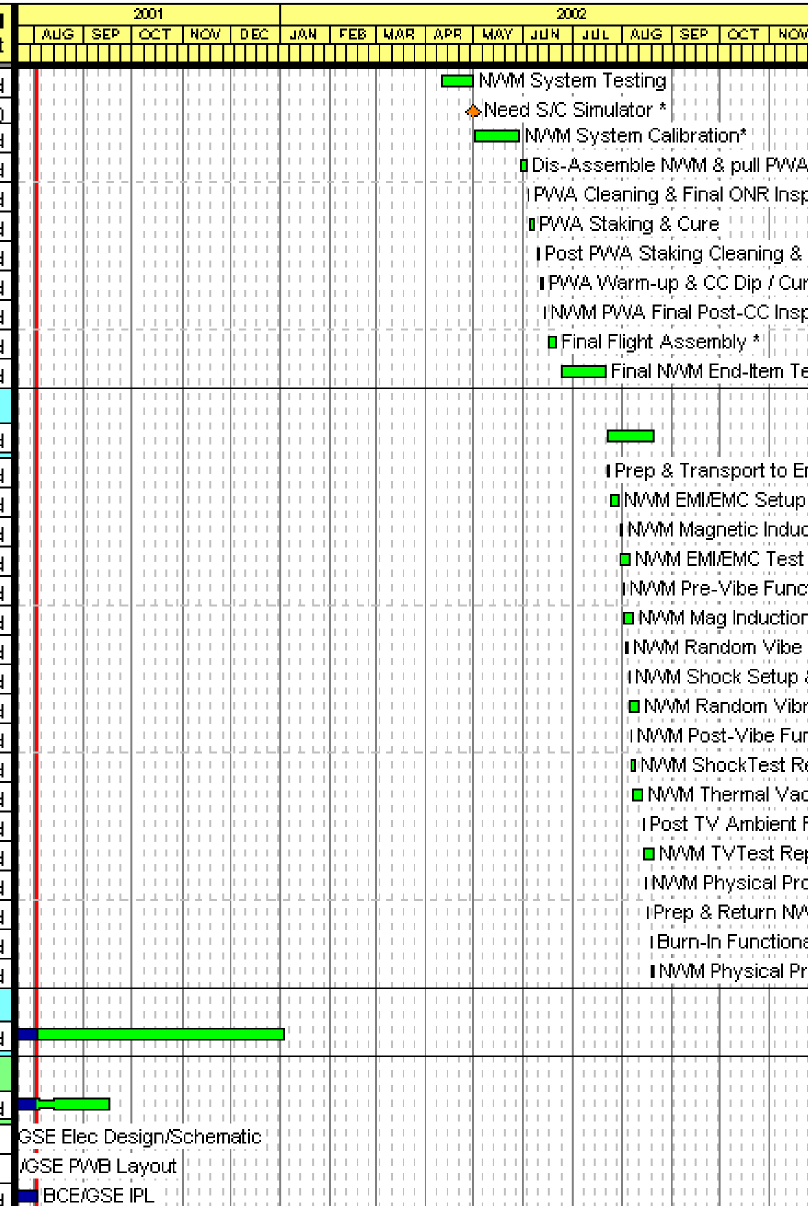
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNMW2516	EBox-1 LVPS PWA PL	1	10 AUG 01	10 AUG 01	155d
CNMW2510	EBox-1 LVPS PWB Drill Drawing	2	13 FEB 02	14 FEB 02	24d
CNMW2513	EBox-1 LVPS PWA Assy Drawing	3	15 FEB 02	19 FEB 02	31d
CNMW2519	Procure EBox-1 LVPS PWB	10	15 FEB 02	28 FEB 02	24d
CNMW2068[	EBox Board Interconnect Definition	5	20 FEB 02	26 FEB 02	23d
CNMW2525	EBox-1 LVPS PWA Kitting & Traveler Prep	3	26 FEB 02	28 FEB 02	24d
CNMW2528	EBox-1 LVPS PWA Assembly	3	01 MAR 02	05 MAR 02	24d
CNMW2531	EBox-1 LVPS PWA Initial Checkout & Tuning	2	06 MAR 02	07 MAR 02	24d
CNMW2534	EBox-1 LVPS PWA Stand-Alone Verification	5	08 MAR 02	14 MAR 02	24d
EBox-2 / A/D & D/A Converter PWA					
		166	26 JUN 01	05 APR 02	8d
CNMW2547	EBox-2 A/D-D/A Conv PWA Schematic	1	26 JUN 01	03 AUG 01	135d
CNMW2557	EBox-2 A/D-D/A Conv PWB Layout	138 *	26 JUN 01	26 FEB 02	8d
CNMW2587	EBox-2 A/D-D/A Conv PWA PL	1	26 JUN 01	03 AUG 01	156d
CNMW2567	EBox-2 A/D-D/A Conv PWB Drill Drawing	2	27 FEB 02	28 FEB 02	8d
CNMW2577	EBox-2 A/D-D/A Conv PWA Assy Drawing	3	01 MAR 02	05 MAR 02	15d
CNMW2597	Procure EBox-2 A/D-D/A Conv PWB	10	01 MAR 02	14 MAR 02	8d
CNMW2617	EBox-2 A/D-D/A Conv PWA Kitting & Traveler Prep	1	14 MAR 02	14 MAR 02	8d
CNMW2627	EBox-2 A/D-D/A Conv PWA Assembly	3	15 MAR 02	19 MAR 02	8d
CNMW2637	EBox-2 A/D-D/A Conv PWA Initial C/O & Tuning	2	20 MAR 02	21 MAR 02	8d
CNMW2647	EBox-2 A/D-D/A Conv PWA Stand-Alone Verify	5	22 MAR 02	28 MAR 02	8d
CNMW2512	Changeout LL Flt. D/A & A/D on EBox-2 PWA	3	29 MAR 02	02 APR 02	8d
CNMW2518	ReTest EBox-2 A/D-D/A Conv PWA	3	03 APR 02	05 APR 02	8d
EBox-3 / Digital Controller PWA					
		167	26 JUN 01	08 APR 02	7d
CNMW2651	FPGA & Non-Rad 1553 RT Procurement	64 *	26 JUN 01	01 NOV 01	89d
CNMW2643	EBox-3 Digital Control PWA Schematic	5	29 JUN 01	09 AUG 01	14d
CNMW2646	EBox-3 Digital Control PWB Layout	116 *	03 AUG 01	25 JAN 02	14d
CNMW2655	EBox-3 Digital Control PWA PL	3	03 AUG 01	07 AUG 01	150d
CNMW2649	EBox-3 Digital Control PWB Drill Drawing	2	28 JAN 02	29 JAN 02	14d
CNMW2652	EBox-3 Digital Control PWA Assy Drawing	5	30 JAN 02	05 FEB 02	29d
CNMW2658	Procure EBox-3 Digital Control PWB	10	30 JAN 02	12 FEB 02	14d
CNMW2661	EBox-3 Digital Control PWB Coupon Test @ GSFC	10	13 FEB 02	26 FEB 02	14d
CNMW2664	EBox-3 Digital Control PWA Kit & Traveler Prep	1	27 FEB 02	27 FEB 02	14d
CNMW2667	EBox-3 Digital Control PWA Assembly	3	28 FEB 02	04 MAR 02	14d
CNMW2670	EBox-3 Digital Control PWA Initial C/O & Tuning	7	05 MAR 02	13 MAR 02	14d
CNMW1484	EBox-3 Digital Control PWA Verif Test Proc	10	11 MAR 02	22 MAR 02	7d
CNMW2673	EBox-3 Digital Control PWA Stand-Alone Verify	5	25 MAR 02	29 MAR 02	7d
CNMW2245	Changeout LL Flt. 1553 RT on Digital Control PWA	3	01 APR 02	03 APR 02	7d



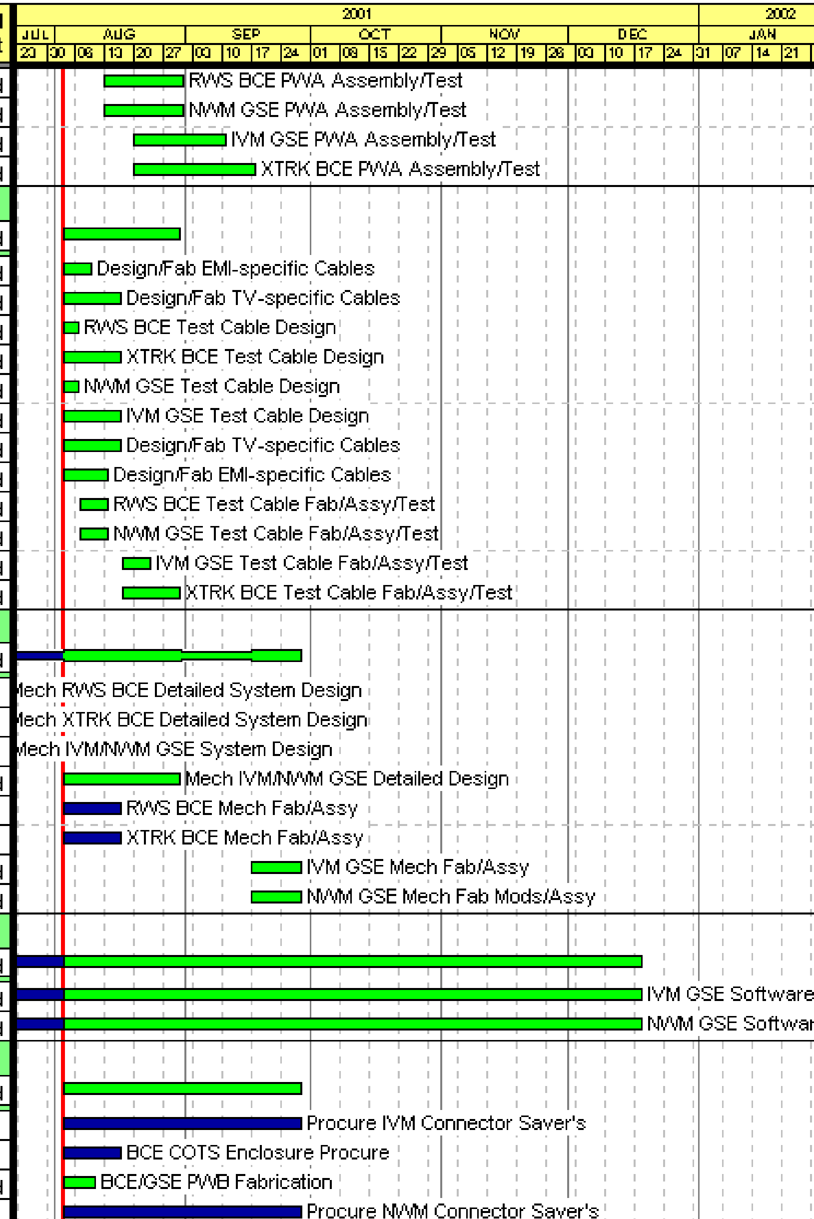
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNNW2254	ReTest EBox-3 Digital Control PWA	3	04 APR 02	08 APR 02	7d
EBox-3 PWA FPGA					
		50	03 AUG 01	12 OCT 01	103d
CNNW2645	EBox-3 FPGA Design	20	03 AUG 01	30 AUG 01	103d
CNNW2648	EBox-3 Digital Control FPGA Coding	30	31 AUG 01	12 OCT 01	103d
EBox Assy & Test					
		2	09 APR 02	10 APR 02	6d
CNNW2233	Assemble 4-sides of EBox Enclosure	1	09 APR 02	09 APR 02	6d
CNNW2236	Temporary Stack EBox PWAs into Enclosure	1	10 APR 02	10 APR 02	6d
Intra-NWM Cables					
		16	03 AUG 01	24 AUG 01	159d
CNNW2820	Design RWS E-Box I/F Cable	5	03 AUG 01	09 AUG 01	159d
CNNW2825	Design XTRK-EBox I/F Cable 1	5	03 AUG 01	09 AUG 01	159d
CNNW2830	Design XTRK-EBox I/F Cable 2	5	03 AUG 01	09 AUG 01	159d
CNNW2814	Complete RWS-EBox Cable Fab Dwgs	5	10 AUG 01	16 AUG 01	159d
CNNW2819	Complete XTRK-EBox Cable Fab Dwgs 1	5	10 AUG 01	16 AUG 01	159d
CNNW2824	Complete XTRK-EBox Cable Fab Dwgs 2	5	10 AUG 01	16 AUG 01	159d
CNNW2817	Fabricate RWS-EBox I/F Cable	5	17 AUG 01	23 AUG 01	159d
CNNW2822	Fabricate XTRK-EBox I/F Cable 1	5	17 AUG 01	23 AUG 01	159d
CNNW2827	Fabricate XTRK-EBox I/F Cable 2	5	17 AUG 01	23 AUG 01	159d
CNNW2811	Test RWS-EBox I/F Cable	1	24 AUG 01	24 AUG 01	159d
CNNW2816	Test XTRK-EBox I/F Cable 1	1	24 AUG 01	24 AUG 01	159d
CNNW2821	Test XTRK-EBox I/F Cable 2	1	24 AUG 01	24 AUG 01	159d
NWM Parts Procurement					
		98	01 MAY 01	02 JAN 02	148d
CNNW2155	Select & Procure Magnet (Hourseshoe)	0	01 MAY 01	26 JUN 01	
CNIV2854	Non-Rad 1553 RT & FPGA Procurement	64 *	26 JUN 01	01 NOV 01	92d
CNNW2135	Multiplier Procurement	40	26 JUN 01	28 SEP 01	126d
CNNW2252	RWS-4 Power Mosfets Procurement	26 *	26 JUN 01	10 SEP 01	137d
CNNW1260	Solenoid Procurement	40	03 AUG 01	28 SEP 01	17d
CNNW1312	Ferrite Cup Core Housing Procurement	20	03 AUG 01	30 AUG 01	141d
CNNW1480	Procure Shipping Container	13	03 AUG 01	21 AUG 01	233d
CNNW2158	Procure Ion Source Feedthrough & Ceramics	0	03 AUG 01	16 AUG 01	
CNNW2515	Receive D/A and A/D Flight Parts	0	03 DEC 01 *		85d
CNNW2290	Receive 1553 Flight Parts	0	02 JAN 02 *		70d
NWM Assembly & Test					
		71	10 APR 02	22 JUL 02	6d
CNNW2833	NWM Subassemblies Complete	0		10 APR 02	6d



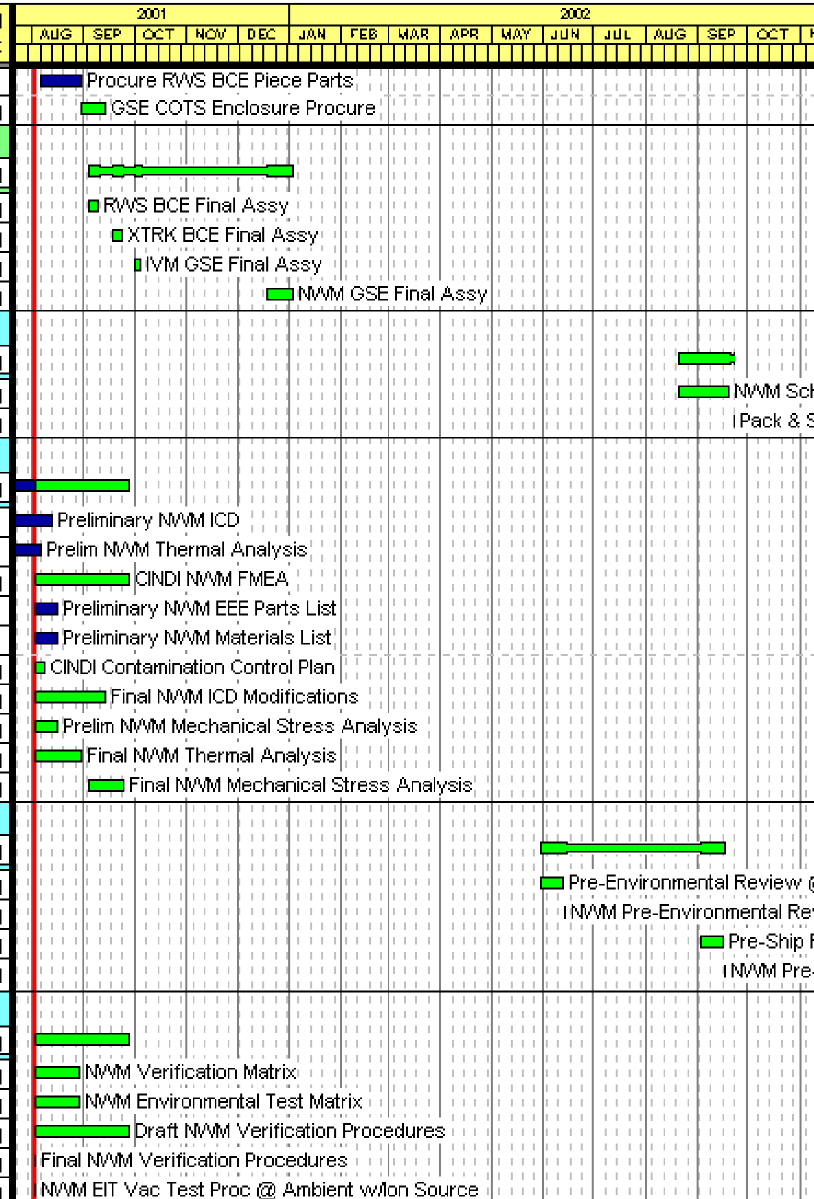
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNNW1420	NWM System Testing	15	11 APR 02	01 MAY 02	6d
CNNW1890	Need S/C Simulator *	0		30 APR 02	0
CNNW1421	NWM System Calibration*	20	02 MAY 02	30 MAY 02	6d
CNNW1493	Dis-Assemble NWM & pull PWA's	2	31 MAY 02	03 JUN 02	6d
CNNW1496	PWA Cleaning & Final ONR Inspection	1	04 JUN 02	04 JUN 02	6d
CNNW1499	PWA Staking & Cure	3	05 JUN 02	07 JUN 02	6d
CNNW1502	Post PWA Staking Cleaning & Inspect	2	10 JUN 02	11 JUN 02	6d
CNNW1505	PWA Warm-up & CC Dip / Cure	2	12 JUN 02	13 JUN 02	6d
CNNW1508	NWM PWA Final Post-CC Inspect	1	14 JUN 02	14 JUN 02	6d
CNNW1440	Final Flight Assembly *	5	17 JUN 02	21 JUN 02	6d
CNNW1450	Final NWM End-Item Testing	20	24 JUN 02	22 JUL 02	6d
NWM Environmental Testing					
		22	23 JUL 02	21 AUG 02	25d
CNNW1453	Prep & Transport to Env. Test Site	2	23 JUL 02	24 JUL 02	7d
CNNW1456	NWM EMI/EMC Setup & Testing	5	25 JUL 02	30 JUL 02	7d
CNNW1459	NWM Magnetic Induction Setup & Testing	2	31 JUL 02	01 AUG 02	7d
CNNW1513	NWM EMI/EMC Test Report	5	31 JUL 02	06 AUG 02	35d
CNNW1462	NWM Pre-Vibe Functional Testing	1	02 AUG 02	02 AUG 02	7d
CNNW1507	NWM Mag Induction Test Report	5	02 AUG 02	08 AUG 02	34d
CNNW1465	NWM Random Vibe (3-Axis) Setup & Testing	2	03 AUG 02	05 AUG 02	7d
CNNW1468	NWM Shock Setup & Testing	1	06 AUG 02	06 AUG 02	7d
CNNW1495	NWM Random VibrationTest Report	5	06 AUG 02	12 AUG 02	32d
CNNW1477	NWM Post-Vibe Functional Testing	1	07 AUG 02	07 AUG 02	7d
CNNW1498	NWM ShockTest Report	3	07 AUG 02	09 AUG 02	32d
CNNW1471	NWM Thermal Vacuum Setup & Testing	7	08 AUG 02	14 AUG 02	8d
CNNW1483	Post TV Ambient Functional Test	1	15 AUG 02	15 AUG 02	6d
CNNW1501	NWM TVTest Report	5	15 AUG 02	21 AUG 02	25d
CNNW1474	NWM Physical Properties	1	16 AUG 02	16 AUG 02	7d
CNNW1489	Prep & Return NWM to UTD	1	17 AUG 02	17 AUG 02	8d
CNNW1486	Burn-In Functional Test (Meet Cum 200 Hrs.)	2	19 AUG 02	20 AUG 02	5d
CNNW1504	NWM Physical Properties Report	3	19 AUG 02	21 AUG 02	25d
BCE/GSE Test Equipment					
		100	01 JUN 01	03 JAN 02	158d
Electronics					
		31	01 JUN 01	17 SEP 01	139d
CNNW1200	BCE/GSE Elec Design/Schematic	0 *	01 JUN 01	22 JUN 01	
CNNW1203	BCE/GSE PWB Layout	0	25 JUN 01	27 JUN 01	
CNNW1254	BCE/GSE IPL	1	26 JUN 01	03 AUG 01	154d



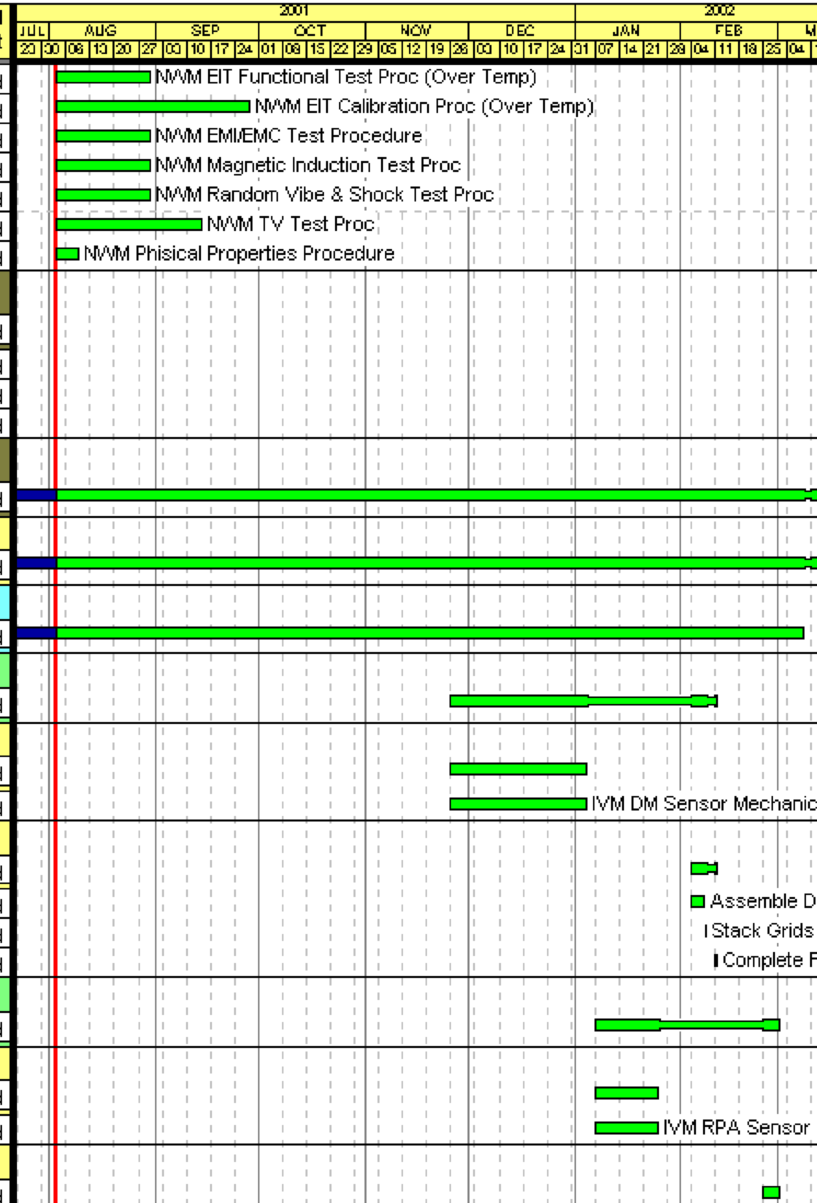
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNMW1210	RWS BCE PWA Assembly/Test	15	13 AUG 01	31 AUG 01	149d
CNMW1265	NWM GSE PWA Assembly/Test	15	13 AUG 01	31 AUG 01	149d
CNIV1268	IVM GSE PWA Assembly/Test	15	20 AUG 01	10 SEP 01	142d
CNMW1240	XTRK BCE PWA Assembly/Test	20	20 AUG 01	17 SEP 01	139d
Cables					
		20	03 AUG 01	30 AUG 01	238d
CNIV1558	Design/Fab EMI-specific Cables	5	03 AUG 01	09 AUG 01	220d
CNIV1681	Design/Fab TV-specific Cables	10	03 AUG 01	16 AUG 01	224d
CNMW1245	RWS BCE Test Cable Design	2	03 AUG 01	06 AUG 01	163d
CNMW1251	XTRK BCE Test Cable Design	10	03 AUG 01	16 AUG 01	150d
CNMW1283	NWM GSE Test Cable Design	2	03 AUG 01	06 AUG 01	163d
CNMW1286	IVM GSE Test Cable Design	10	03 AUG 01	16 AUG 01	153d
CNMW1460	Design/Fab TV-specific Cables	10	03 AUG 01	16 AUG 01	248d
CNMW1525	Design/Fab EMI-specific Cables	7	03 AUG 01	13 AUG 01	241d
CNMW1248	RWS BCE Test Cable Fab/Assy/Test	5	07 AUG 01	13 AUG 01	163d
CNMW1293	NWM GSE Test Cable Fab/Assy/Test	5	07 AUG 01	13 AUG 01	163d
CNIV1296	IVM GSE Test Cable Fab/Assy/Test	5	17 AUG 01	23 AUG 01	153d
CNMW1272	XTRK BCE Test Cable Fab/Assy/Test	10	17 AUG 01	30 AUG 01	150d
Mechanical					
		40	06 JUL 01	28 SEP 01	130d
CNMW1142	Mech RWS BCE Detailed System Design	0	06 JUL 01	19 JUL 01	
CNMW1154	Mech XTRK BCE Detailed System Design	0	06 JUL 01	19 JUL 01	
CNMW1139	Mech IVM/NWM GSE System Design	0	09 JUL 01	20 JUL 01	
CNMW1141	Mech IVM/NWM GSE Detailed Design	20	03 AUG 01	30 AUG 01	128d
CNMW1148	RWS BCE Mech Fab/Assy	0	03 AUG 01	16 AUG 01	
CNMW1151	XTRK BCE Mech Fab/Assy	0	03 AUG 01	16 AUG 01	
CNIV1236	IVM GSE Mech Fab/Assy	10	17 SEP 01	28 SEP 01	128d
CNMW1233	NWM GSE Mech Fab Mods/Assy	10	17 SEP 01	28 SEP 01	130d
GSE Software					
		95	26 JUN 01	18 DEC 01	78d
CNIV1516	IVM GSE Software	95	26 JUN 01	18 DEC 01	78d
CNMW1136	NWM GSE Software	95	26 JUN 01	18 DEC 01	75d
BCE/GSE Procurement					
		30	03 AUG 01	28 SEP 01	128d
CNIV2721	Procure IVM Connector Saver's	0	03 AUG 01	28 SEP 01	
CNMW1145	BCE COTS Enclosure Procure	0	03 AUG 01	16 AUG 01	
CNMW1220	BCE/GSE PWB Fabrication	6	03 AUG 01	10 AUG 01	144d
CNMW2521	Procure NWM Connector Saver's	0	03 AUG 01	28 SEP 01	



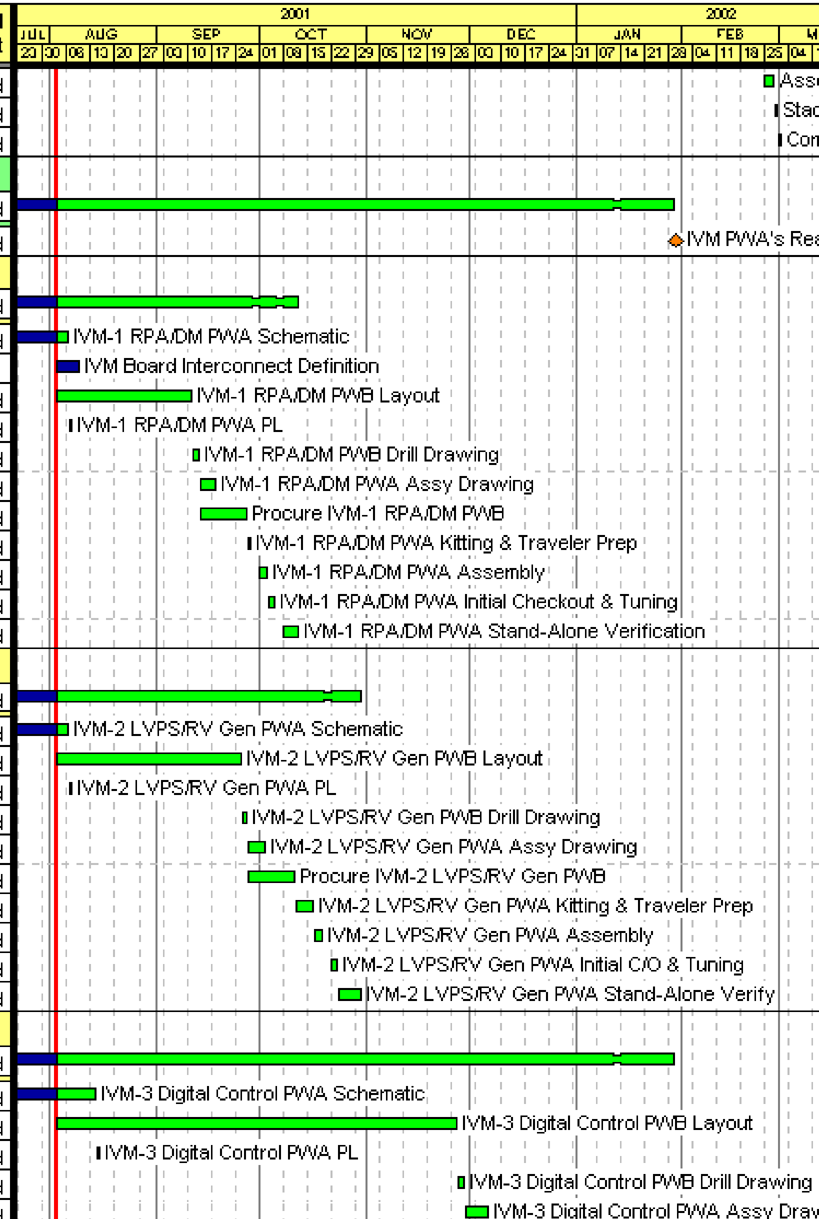
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNNW1257	Procure RWS BCE Piece Parts	0	06 AUG 01	31 AUG 01	
CNNW1230	GSE COTS Enclosure Procure	10	31 AUG 01	14 SEP 01	128d
BCE/GSE Assembly & Test					
		79	04 SEP 01	03 JAN 02	75d
CNNW1213	RWS BCE Final Assy	5	04 SEP 01	10 SEP 01	149d
CNNW1216	XTRK BCE Final Assy	5	18 SEP 01	24 SEP 01	139d
CNIV1242	IVM GSE Final Assy	5	01 OCT 01	05 OCT 01	128d
CNNW1239	NWM GSE Final Assy	5	19 DEC 01	03 JAN 02	75d
NWM Delivery					
		23	21 AUG 02	23 SEP 02	5d
CNNW1510	NWM Schedule Reserve Contingency	22	21 AUG 02	20 SEP 02	5d
CNNW1492	Pack & Ship NWM to KAFD	1	23 SEP 02	23 SEP 02	5d
Specifications / Documentation / Analysis					
		40	01 JUN 01	28 SEP 01	47d
CNNW1263	Preliminary NWM ICD	0 *	01 JUN 01	13 AUG 01	
CNNW1576	Prelim NWM Thermal Analysis	0 *	09 JUL 01	07 AUG 01	
CNA11104	CINDI NWM FMEA	40	03 AUG 01	28 SEP 01	47d
CNA11110	Preliminary NWM EEE Parts List	0	03 AUG 01	16 AUG 01	
CNA11116	Preliminary NWM Materials List	0	03 AUG 01	16 AUG 01	
CNA11125	CINDI Contamination Control Plan	5	03 AUG 01	09 AUG 01	67d
CNNW1266	Final NWM ICD Modifications	30	03 AUG 01	14 SEP 01	9d
CNNW1579	Prelim NWM Mechanical Stress Analysis	10	03 AUG 01	16 AUG 01	29d
CNNW1582	Final NWM Thermal Analysis	21	03 AUG 01	31 AUG 01	18d
CNNW1585	Final NWM Mechanical Stress Analysis	16	04 SEP 01	25 SEP 01	18d
Review Prepartion & Support					
		76	31 MAY 02	17 SEP 02	8d
CNNW1540	Pre-Environmental Review @ UTD-NWM Prep	10	31 MAY 02	13 JUN 02	31d
CNNW1543	NWM Pre-Environmental Revier (PER)	1	14 JUN 02	14 JUN 02	31d
CNNW1560	Pre-Ship Rev/Func Conf Audit @ UTD-NWM Prep	10	03 SEP 02 *	16 SEP 02	8d
CNNW1563	NWM Pre-Ship Review (PSR) @ UTD	1	17 SEP 02	17 SEP 02	8d
NWM Verification / Procedures					
		40	03 AUG 01	28 SEP 01	224d
CNA11128	NWM Verification Matrix	20	03 AUG 01	30 AUG 01	67d
CNA11134	NWM Environmental Test Matrix	20	03 AUG 01	30 AUG 01	67d
CNA11143	Draft NWM Verification Procedures	40	03 AUG 01	28 SEP 01	47d
CNA11149	Final NWM Verification Procedures	1	03 AUG 01	03 AUG 01	244d
CNIV2851	NWM EIT Vac Test Proc @ Ambient w/Ion Source	1	03 AUG 01	03 AUG 01	189d



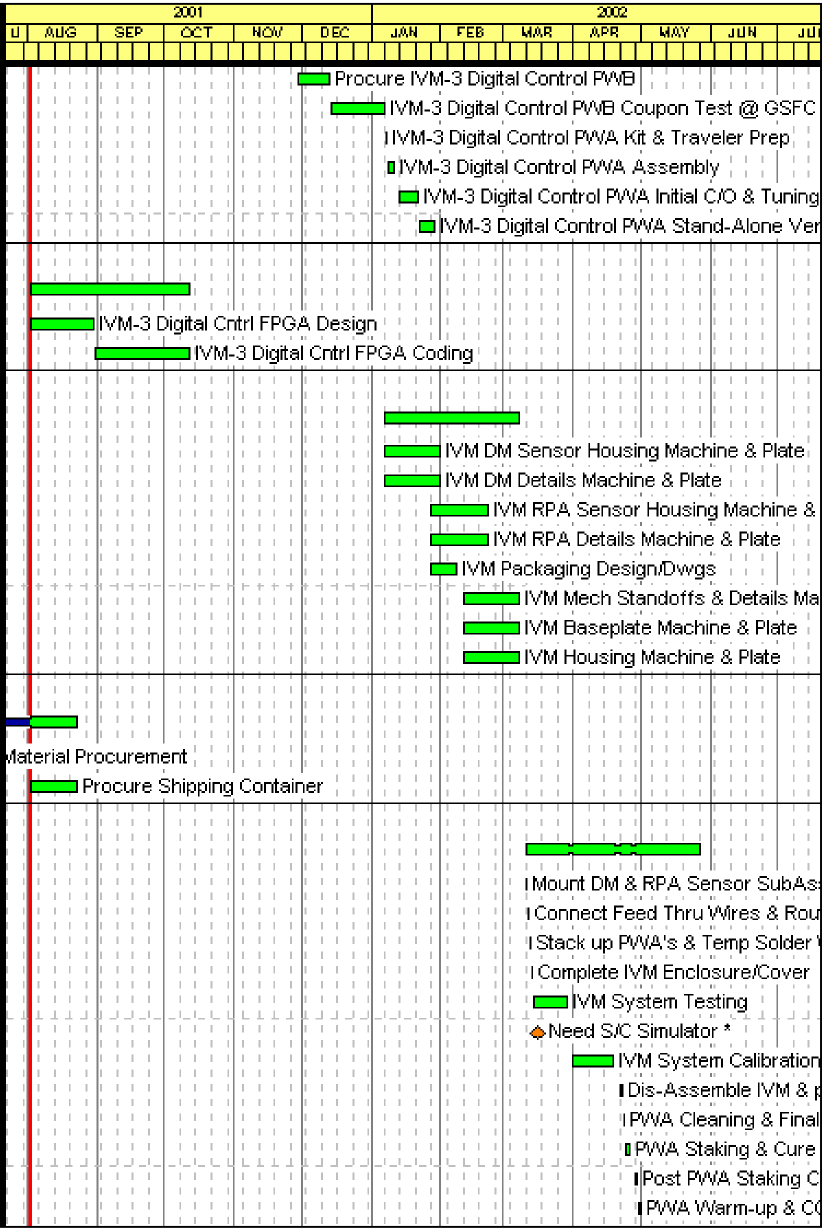
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNMW1427	NMM EIT Functional Test Proc (Over Temp)	20	03 AUG 01	30 AUG 01	155d
CNMW1433	NMM EIT Calibration Proc (Over Temp)	40	03 AUG 01	28 SEP 01	150d
CNMW1436	NMM EMI/EMC Test Procedure	20	03 AUG 01	30 AUG 01	228d
CNMW1439	NMM Magnetic Induction Test Proc	20	03 AUG 01	30 AUG 01	232d
CNMW1442	NMM Random Vibe & Shock Test Proc	20	03 AUG 01	30 AUG 01	234d
CNMW1445	NMM TV Test Proc	30	03 AUG 01	14 SEP 01	228d
CNMW1448	NMM Phisical Properties Procedure	5	03 AUG 01	09 AUG 01	259d
Education / Public Outreach					
		510	02 JUN 03	14 JUN 05	12d
CNA11073	Teacher Workshop in Dallas, TX	10	02 JUN 03 *	13 JUN 03	492d
CNA11076	Teacher Workshop in Victoria, TX	10	01 JUN 04 *	14 JUN 04	252d
CNA11079	Teacher Workshop in Victoria, TX	10	01 JUN 05 *	14 JUN 05	12d
Ion Velocity Meter (IVM) Development					
		266	01 JUN 01	27 AUG 02	3d
IVM Instrument					
		266	01 JUN 01	27 AUG 02	3d
IVM Design & Fabrication					
		146	26 JUN 01	08 MAR 02	78d
IVM Drift Meter (DM)					
		49	26 NOV 01	11 FEB 02	42d
DM Housing & Mechanical Details					
		23	26 NOV 01	04 JAN 02	6d
CNIV1080	IVM DM Sensor Mechanical Design/Dwgs	23	26 NOV 01	04 JAN 02	6d
DM Sensor Assembly & Test					
		6	04 FEB 02	11 FEB 02	42d
CNIV2848	Assemble DM Grid, Ring, & Grid Mounts (x7) Trim	4	04 FEB 02	07 FEB 02	42d
CNIV2836	Stack Grids (5) & Collector Plates (4) on DM B/P	1	08 FEB 02	08 FEB 02	42d
CNIV2710	Complete Final Assembly of DM Sensor	1	11 FEB 02	11 FEB 02	42d
IVM Retarding Potential Analyzer (RPA)					
		40	07 JAN 02	01 MAR 02	28d
RPA Housing & Mechanical Details					
		15	07 JAN 02	25 JAN 02	23d
CNIV2646	IVM RPA Sensor Mechanical Design/Dwgs	15	07 JAN 02	25 JAN 02	23d
RPA Sensor Assembly & Test					
		5	25 FEB 02	01 MAR 02	28d



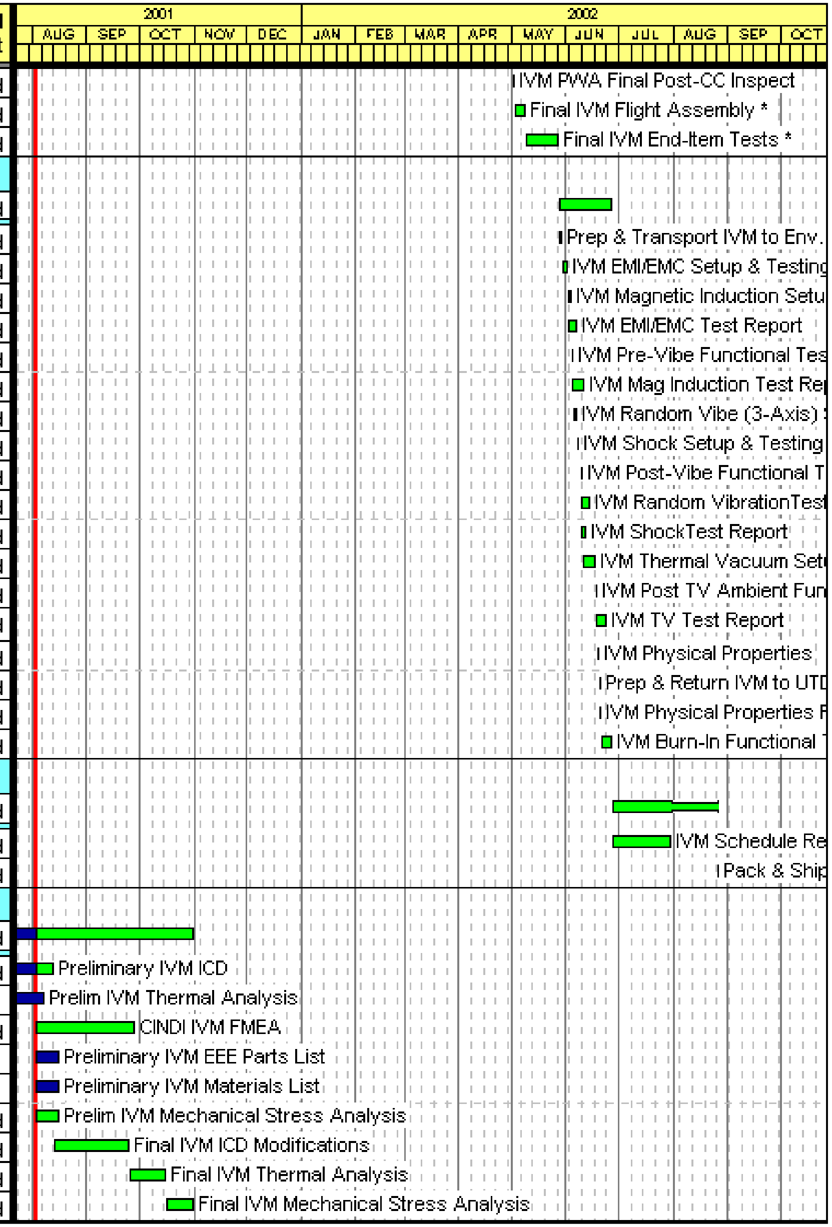
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNIV2619	Assemble RPA Grid, Ring, & Grid Mounts (x6) Trim	3	25 FEB 02	27 FEB 02	28d
CNIV2839	Stack Grids (6) &Collector Plates (1) on RPA B/P	1	28 FEB 02	28 FEB 02	28d
CNIV2613	Complete Final Assembly of RPA Sensor	1	01 MAR 02	01 MAR 02	28d
IVM Electronics					
		118	26 JUN 01	29 JAN 02	53d
CNIV2713	IVM PWA's Ready for Next Higher Assy	0		29 JAN 02	53d
IVM-1 / RPA/DM Electrometers PWA					
		50	26 JUN 01	12 OCT 01	121d
CNIV2725	IVM-1 RPA/DM PWA Schematic	2	26 JUN 01	06 AUG 01	157d
CNIV2726	IVM Board Interconnect Definition	0	03 AUG 01	09 AUG 01	
CNIV2728	IVM-1 RPA/DM PWB Layout	27 *	03 AUG 01	11 SEP 01	121d
CNIV2737	IVM-1 RPA/DM PWA PL	1	07 AUG 01	07 AUG 01	157d
CNIV2731	IVM-1 RPA/DM PWB Drill Drawing	2	12 SEP 01	13 SEP 01	121d
CNIV2734	IVM-1 RPA/DM PWA Assy Drawing	3	14 SEP 01	18 SEP 01	129d
CNIV2740	Procure IVM-1 RPA/DM PWB	10	14 SEP 01	27 SEP 01	121d
CNIV2746	IVM-1 RPA/DM PWA Kitting & Traveler Prep	1	28 SEP 01	28 SEP 01	121d
CNIV2749	IVM-1 RPA/DM PWA Assembly	3	01 OCT 01	03 OCT 01	121d
CNIV2752	IVM-1 RPA/DM PWA Initial Checkout & Tuning	2	04 OCT 01	05 OCT 01	121d
CNIV2755	IVM-1 RPA/DM PWA Stand-Alone Verification	5	08 OCT 01	12 OCT 01	121d
IVM-2 / LVPS & RV Generator PWA					
		62	28 JUN 01	30 OCT 01	109d
CNIV2761	IVM-2 LVPS/RV Gen PWA Schematic	2	28 JUN 01	06 AUG 01	155d
CNIV2764	IVM-2 LVPS/RV Gen PWB Layout	37 *	03 AUG 01	25 SEP 01	109d
CNIV2773	IVM-2 LVPS/RV Gen PWA PL	1	07 AUG 01	07 AUG 01	155d
CNIV2767	IVM-2 LVPS/RV Gen PWB Drill Drawing	2	26 SEP 01	27 SEP 01	109d
CNIV2770	IVM-2 LVPS/RV Gen PWA Assy Drawing	3	28 SEP 01	02 OCT 01	119d
CNIV2776	Procure IVM-2 LVPS/RV Gen PWB	10	28 SEP 01	11 OCT 01	109d
CNIV2782	IVM-2 LVPS/RV Gen PWA Kitting & Traveler Prep	3	12 OCT 01	16 OCT 01	109d
CNIV2785	IVM-2 LVPS/RV Gen PWA Assembly	3	17 OCT 01	19 OCT 01	109d
CNIV2788	IVM-2 LVPS/RV Gen PWA Initial C/O & Tuning	2	22 OCT 01	23 OCT 01	109d
CNIV2803	IVM-2 LVPS/RV Gen PWA Stand-Alone Verify	5	24 OCT 01	30 OCT 01	109d
IVM-3 / Digital Controller PWA					
		118	26 JUN 01	29 JAN 02	53d
CNIV2794	IVM-3 Digital Control PWA Schematic	8	26 JUN 01	14 AUG 01	53d
CNIV2800	IVM-3 Digital Control PWB Layout	80 *	03 AUG 01	27 NOV 01	53d
CNIV2815	IVM-3 Digital Control PWA PL	1	15 AUG 01	15 AUG 01	146d
CNIV2809	IVM-3 Digital Control PWB Drill Drawing	2	28 NOV 01	29 NOV 01	53d
CNIV2812	IVM-3 Digital Control PWA Assy Drawing	5	30 NOV 01	06 DEC 01	69d



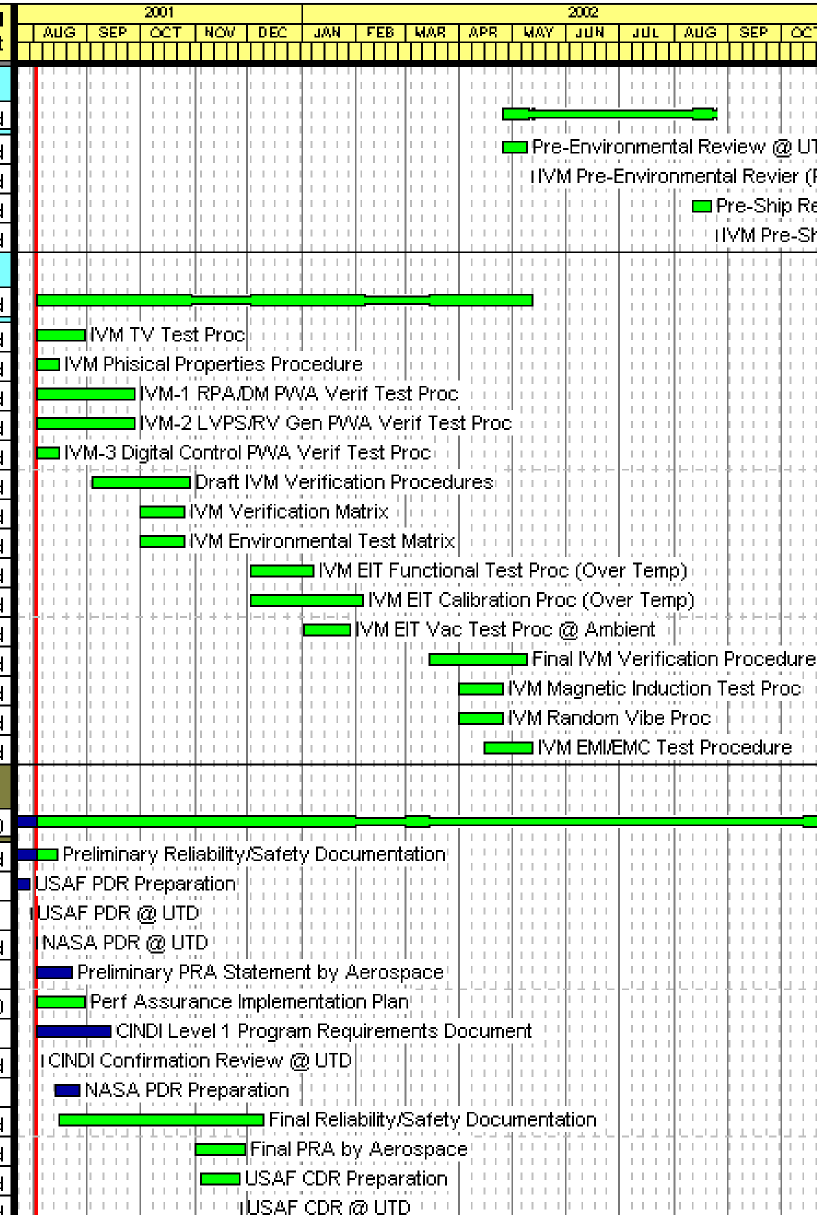
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNIV2818	Procure IVM-3 Digital Control PWB	10	30 NOV 01	13 DEC 01	53d
CNIV2821	IVM-3 Digital Control PWB Coupon Test @ GSFC	10	14 DEC 01	07 JAN 02	53d
CNIV2824	IVM-3 Digital Control PWA Kit & Traveler Prep	1	08 JAN 02	08 JAN 02	53d
CNIV2827	IVM-3 Digital Control PWA Assembly	3	09 JAN 02	11 JAN 02	53d
CNIV2830	IVM-3 Digital Control PWA Initial C/O & Tuning	7	14 JAN 02	22 JAN 02	53d
CNIV2833	IVM-3 Digital Control PWA Stand-Alone Verify	5	23 JAN 02	29 JAN 02	53d
IVM-3 PWA FPGA					
		50	03 AUG 01	12 OCT 01	106d
CNIV2797	IVM-3 Digital Cntrl FPGA Design	20	03 AUG 01	30 AUG 01	106d
CNIV2806	IVM-3 Digital Cntrl FPGA Coding	30	31 AUG 01	12 OCT 01	106d
IVM Mechanical					
		45	07 JAN 02	08 MAR 02	25d
CNIV2625	IVM DM Sensor Housing Machine & Plate	20	07 JAN 02	01 FEB 02	46d
CNIV2640	IVM DM Details Machine & Plate	20	07 JAN 02	01 FEB 02	6d
CNIV2622	IVM RPA Sensor Housing Machine & Plate	20	28 JAN 02	22 FEB 02	31d
CNIV2637	IVM RPA Details Machine & Plate	20	28 JAN 02	22 FEB 02	28d
CNIV2643	IVM Packaging Design/Dwgs	10	28 JAN 02	08 FEB 02	23d
CNIV2628	IVM Mech Standoffs & Details Machine & Plate	20	11 FEB 02	08 MAR 02	25d
CNIV2631	IVM Baseplate Machine & Plate	20	11 FEB 02	08 MAR 02	23d
CNIV2634	IVM Housing Machine & Plate	20	11 FEB 02	08 MAR 02	25d
IVM Parts Procurement					
		15	26 JUN 01	23 AUG 01	209d
CNIV2845	GRID Material Procurement	0	26 JUN 01	26 JUN 01	
CNIV1678	Procure Shipping Container	15	03 AUG 01	23 AUG 01	209d
IVM Assembly & Test					
		55	11 MAR 02	27 MAY 02	23d
CNIV2719	Mount DM & RPA Sensor SubAssy's to IVM	1	11 MAR 02	11 MAR 02	23d
CNIV2712	Connect Feed Thru Wires & Route (x7)	1	12 MAR 02	12 MAR 02	23d
CNIV2718	Stack up PWA's & Temp Solder Wire Connects	1	13 MAR 02	13 MAR 02	23d
CNIV2727	Complete IVM Enclosure/Cover	1	14 MAR 02	14 MAR 02	23d
CNIV1537	IVM System Testing	11	15 MAR 02	29 MAR 02	23d
CNIV1663	Need S/C Simulator *	0		15 MAR 02	0
CNIV1540	IVM System Calibration*	15	01 APR 02	19 APR 02	23d
CNIV1612	Dis-Assemble IVM & pull PWA's	2	22 APR 02	23 APR 02	23d
CNIV1618	PWA Cleaning & Final ONR Inspection	1	24 APR 02	24 APR 02	23d
CNIV1624	PWA Staking & Cure	2	25 APR 02	26 APR 02	23d
CNIV1630	Post PWA Staking Cleaning & Inspect	1	29 APR 02	29 APR 02	23d
CNIV1636	PWA Warm-up & CC Dip / Cure	2	30 APR 02	01 MAY 02	23d



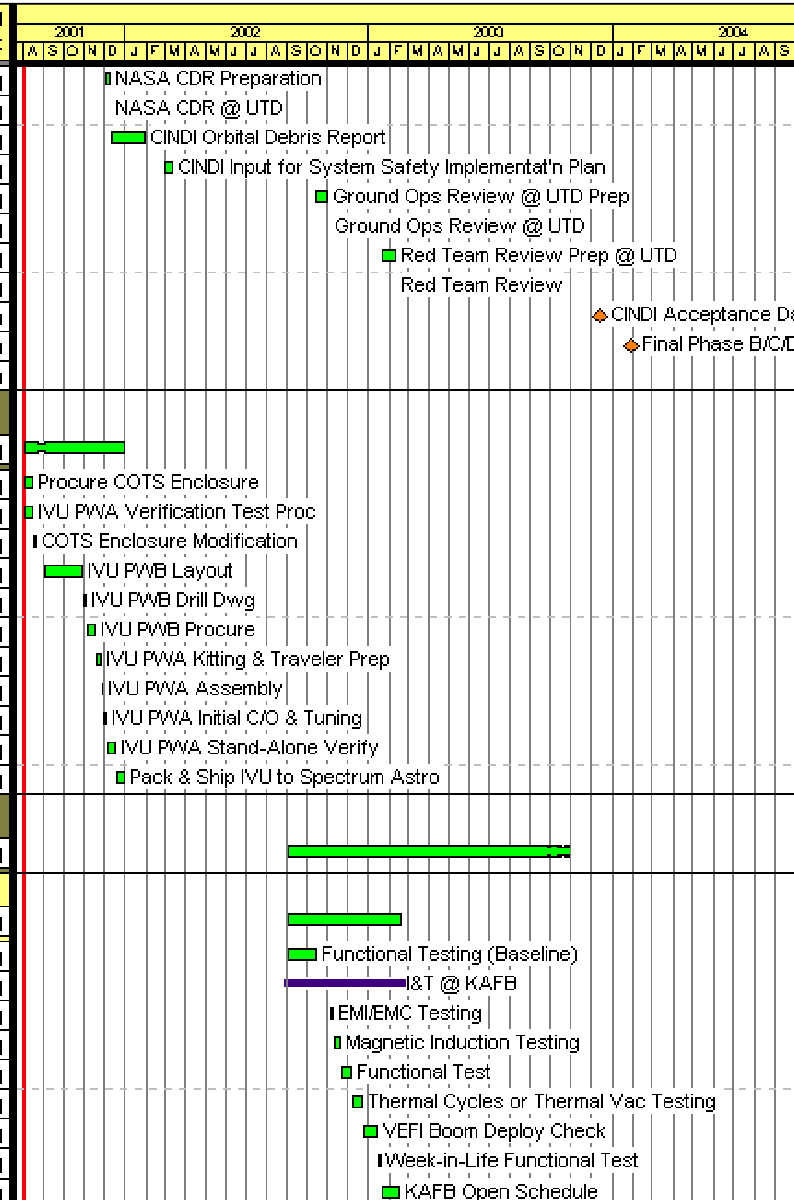
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNIV1642	IVM PWA Final Post-CC Inspect	1	02 MAY 02	02 MAY 02	23d
CNIV1555	Final IVM Flight Assembly *	3	03 MAY 02	08 MAY 02	23d
CNIV1567	Final IVM End-Item Tests *	13	09 MAY 02	27 MAY 02	23d
IVM Environmental Testing					
		23	28 MAY 02	27 JUN 02	43d
CNIV1570	Prep & Transport IVM to Env. Test Site	2	28 MAY 02	29 MAY 02	27d
CNIV1573	IVM EMI/EMC Setup & Testing	3	30 MAY 02	01 JUN 02	27d
CNIV1576	IVM Magnetic Induction Setup & Testing	2	03 JUN 02	04 JUN 02	27d
CNIV1648	IVM EMI/EMC Test Report	5	03 JUN 02	07 JUN 02	56d
CNIV1582	IVM Pre-Vibe Functional Testing	1	05 JUN 02	05 JUN 02	27d
CNIV1639	IVM Mag Induction Test Report	5	05 JUN 02	11 JUN 02	55d
CNIV1585	IVM Random Vibe (3-Axis) Setup & Testing	2	06 JUN 02	07 JUN 02	27d
CNIV1588	IVM Shock Setup & Testing	1	08 JUN 02	08 JUN 02	27d
CNIV1597	IVM Post-Vibe Functional Testing	1	10 JUN 02	10 JUN 02	27d
CNIV1615	IVM Random VibrationTest Report	5	10 JUN 02	14 JUN 02	52d
CNIV1621	IVM ShockTest Report	3	10 JUN 02	12 JUN 02	53d
CNIV1591	IVM Thermal Vacuum Setup & Testing	7	11 JUN 02	17 JUN 02	31d
CNIV1600	IVM Post TV Ambient Functional Test	1	18 JUN 02	18 JUN 02	27d
CNIV1627	IVM TV Test Report	5	18 JUN 02	24 JUN 02	46d
CNIV1594	IVM Physical Properties	1	19 JUN 02	19 JUN 02	27d
CNIV1606	Prep & Return IVM to UTD	1	20 JUN 02	20 JUN 02	32d
CNIV1633	IVM Physical Properties Report	2	20 JUN 02	21 JUN 02	47d
CNIV1603	IVM Burn-In Functional Test (Meet Cum 200 Hrs.)	5	21 JUN 02	27 JUN 02	22d
IVM Delivery					
		42	28 JUN 02	27 AUG 02	3d
CNIV1645	IVM Schedule Reserve Contingency	22	28 JUN 02	30 JUL 02	22d
CNIV1609	Pack & Ship IVM to KAFD	1	27 AUG 02	27 AUG 02	3d
Specifications / Documentation / Analysis					
		63	01 JUN 01	31 OCT 01	18d
CNIV1273	Preliminary IVM ICD	7 *	01 JUN 01	13 AUG 01	1d
CNIV1279	Prelim IVM Thermal Analysis	0 *	09 JUL 01	07 AUG 01	
CNA11101	CINDI IVM FMEA	40	03 AUG 01	28 SEP 01	32d
CNA11107	Preliminary IVM EEE Parts List	0	03 AUG 01	16 AUG 01	
CNA11113	Preliminary IVM Materials List	0	03 AUG 01	16 AUG 01	
CNIV1282	Prelim IVM Mechanical Stress Analysis	10	03 AUG 01	16 AUG 01	60d
CNIV1276	Final IVM ICD Modifications	30	14 AUG 01	25 SEP 01	2d
CNIV1285	Final IVM Thermal Analysis	15	26 SEP 01	16 OCT 01	18d
CNIV1288	Final IVM Mechanical Stress Analysis	11	17 OCT 01	31 OCT 01	18d



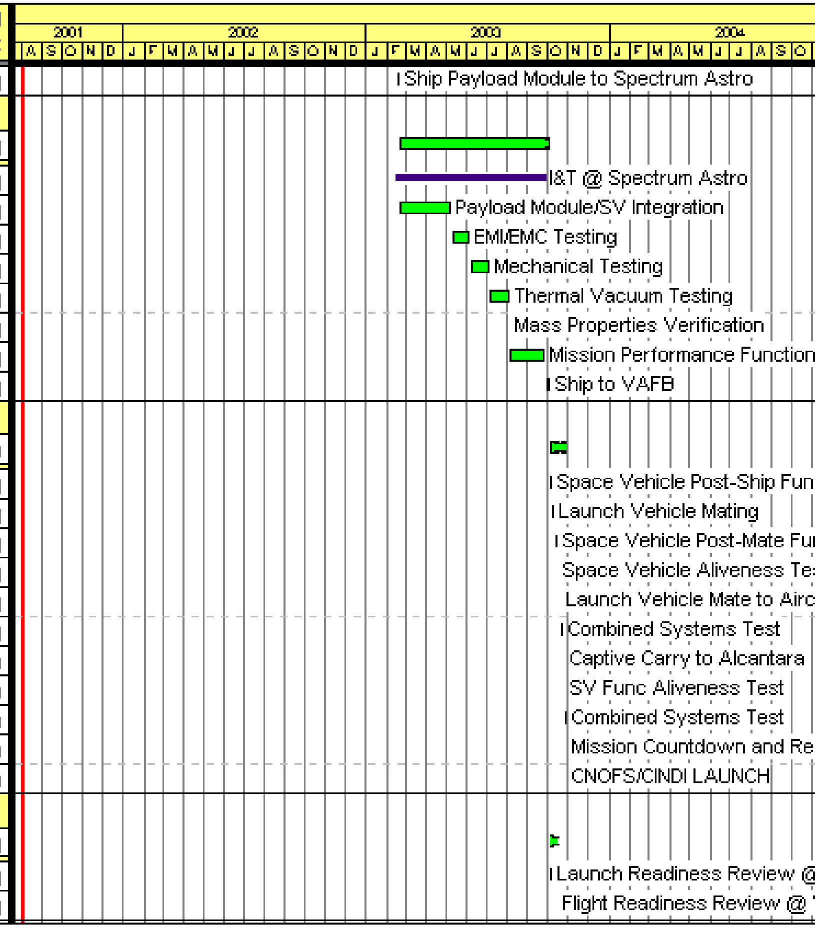
Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
Review Prepartion & Support					
		85	26 APR 02	26 AUG 02	3d
CNIV1651	Pre-Environmental Review @ UTD-IVM Prep	10	26 APR 02	10 MAY 02	33d
CNIV1654	IVM Pre-Environmental Revier (PER)	1	13 MAY 02	13 MAY 02	33d
CNIV1657	Pre-Ship Rev/Func Conf Audit @ UTD-IVM Prep	10	12 AUG 02	23 AUG 02	3d
CNIV1660	IVM Pre-Ship Review (PSR) @ UTD	1	26 AUG 02	26 AUG 02	3d
IVM Verification / Procedures					
		191	03 AUG 01	13 MAY 02	48d
CNIV1672	IVM TV Test Proc	20	03 AUG 01	30 AUG 01	214d
CNIV1675	IVM Phisical Properties Procedure	10	03 AUG 01	16 AUG 01	229d
CNIV2701	IVM-1 RPA/DM PWA Verif Test Proc	40	03 AUG 01	28 SEP 01	126d
CNIV2704	IVM-2 LVPS/RV Gen PWA Verif Test Proc	40	03 AUG 01	28 SEP 01	126d
CNIV2707	IVM-3 Digital Control PWA Verif Test Proc	10	03 AUG 01	16 AUG 01	156d
CNA11137	Draft IVM Verification Procedures	40	04 SEP 01 *	29 OCT 01	26d
CNA11122	IVM Verification Matrix	20	01 OCT 01	26 OCT 01	27d
CNA11131	IVM Environmental Test Matrix	20	01 OCT 01	26 OCT 01	27d
CNIV1543	IVM EIT Functional Test Proc (Over Temp)	20	03 DEC 01 *	08 JAN 02	70d
CNIV1546	IVM EIT Calibration Proc (Over Temp)	40	03 DEC 01 *	05 FEB 02	61d
CNIV1507	IVM EIT Vac Test Proc @ Ambient	20	02 JAN 02 *	29 JAN 02	93d
CNA11146	Final IVM Verification Procedures	40	15 MAR 02	10 MAY 02	33d
CNIV1552	IVM Magnetic Induction Test Proc	20	01 APR 02	26 APR 02	47d
CNIV1669	IVM Random Vibe Proc	20	01 APR 02	26 APR 02	49d
CNIV1549	IVM EMI/EMC Test Procedure	20	15 APR 02	13 MAY 02	34d
CINDI Project Level Activity					
		1373	02 APR 01	12 JAN 07	0
CNA01480	Preliminary Reliability/Safety Documentation	9 *	02 APR 01	15 AUG 01	3d
CNA11053	USAF PDR Preparation	0 *	16 JUL 01	30 JUL 01	
CNA11056	USAF PDR @ UTD	0	31 JUL 01	31 JUL 01	
CNA11062	NASA PDR @ UTD	1	03 AUG 01	03 AUG 01	17d
CNA11083	Preliminary PRA Statement by Aerospace	0	03 AUG 01	23 AUG 01	
CNA11095	Perf Assurance Implementation Plan	21	03 AUG 01	31 AUG 01	0
CNA11098	CINDI Level 1 Program Requirements Document	0	03 AUG 01	14 SEP 01	
CNA11077	CINDI Confirmation Review @ UTD	1	06 AUG 01	06 AUG 01	18d
CNA11059	NASA PDR Preparation	0	14 AUG 01	27 AUG 01	
CNA01483	Final Reliability/Safety Documentation	80	16 AUG 01	10 DEC 01	3d
CNA11086	Final PRA by Aerospace	20	01 NOV 01	30 NOV 01	9d
CNA11065	USAF CDR Preparation	15	05 NOV 01	27 NOV 01	1d
CNA11068	USAF CDR @ UTD	1	28 NOV 01	28 NOV 01	1d



Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNA11071	NASA CDR Preparation	5	04 DEC 01	10 DEC 01	3d
CNA11074	NASA CDR @ UTD	1	11 DEC 01	11 DEC 01	3d
CNA11152	CINDI Orbital Debris Report	30	12 DEC 01	31 JAN 02	31d
CNA11063	CINDI Input for System Safety Implementat'n Plan	10	01 MAR 02	14 MAR 02	43d
CNNW1570	Ground Ops Review @ UTD Prep	15	14 OCT 02	01 NOV 02	4d
CNNW1573	Ground Ops Review @ UTD	1	04 NOV 02	04 NOV 02	4d
CNNW1586	Red Team Review Prep @ UTD	15	23 JAN 03	12 FEB 03	43d
CNNW1583	Red Team Review	1	13 FEB 03	13 FEB 03	43d
CNA11155	CINDI Acceptance Data Package	0		12 DEC 03 *	0
CNA11158	Final Phase B/C/D Technical Report	0		30 JAN 04 *	0
CNA11161	Final Phase E Report	29	01 DEC 06	12 JAN 07 *	0
Interface Verification Unit					
		99	03 AUG 01	02 JAN 02	42d
CNIVU0002	Procure COTS Enclosure	10	03 AUG 01	16 AUG 01	111d
CNIVU0020	IVU PWA Verification Test Proc	10	03 AUG 01	16 AUG 01	119d
CNIVU0003	COTS Enclosure Modification	3	17 AUG 01	21 AUG 01	111d
CNIVU0044	IVU PWB Layout	41 *	04 SEP 01 *	30 OCT 01	42d
CNIVU0047	IVU PWB Drill Dwg	4	31 OCT 01	05 NOV 01	42d
CNIVU0050	IVU PWB Procure	10	06 NOV 01	19 NOV 01	42d
CNIVU0026	IVU PWA Kitting & Traveler Prep	3	20 NOV 01	26 NOV 01	42d
CNIVU0029	IVU PWA Assembly	3	27 NOV 01	29 NOV 01	42d
CNIVU0032	IVU PWA Initial C/O & Tuning	5	30 NOV 01	06 DEC 01	42d
CNIVU0035	IVU PWA Stand-Alone Verify	10	07 DEC 01	20 DEC 01	42d
CNIVU0038	Pack & Ship IVU to Spectrum Astro	2	21 DEC 01	02 JAN 02	42d
CINDI Post Delivery Activity					
		293	03 SEP 02	31 OCT 03	33d
KAFB Activity					
		115	03 SEP 02	20 FEB 03	4d
CNNW1600	Functional Testing (Baseline)	31	03 SEP 02 *	15 OCT 02	18d
CNNW1736	I&T @ KAFB	115 *	03 SEP 02	20 FEB 03	4d
CNNW1610	EMI/EMC Testing	5	05 NOV 02	11 NOV 02	4d
CNNW1620	Magnetic Induction Testing	7	12 NOV 02	20 NOV 02	4d
CNNW1630	Functional Test	11	21 NOV 02	09 DEC 02	4d
CNNW1640	Thermal Cycles or Thermal Vac Testing	10	10 DEC 02 *	23 DEC 02	4d
CNNW1650	VEFI Boom Deploy Check	11	24 DEC 02	15 JAN 03	4d
CNNW1670	Week-in-Life Functional Test	5	16 JAN 03	22 JAN 03	4d
CNNW1740	KAFB Open Schedule	19	23 JAN 03	18 FEB 03	4d



Act ID	Activity Description	Rem Dur	Early Start	Early Finish	Total Float
CNNW1743	Ship Payload Module to Spectrum Astro	2	19 FEB 03	20 FEB 03	4d
Spectrum Astro CINDI-S/C Integration					
		159	21 FEB 03	06 OCT 03	4d
CNNW1733	I&T @ Spectrum Astro	153 *	21 FEB 03	26 SEP 03	4d
CNNW1880	Payload Module/SV Integration	55	21 FEB 03 *	09 MAY 03	4d
CNNW1680	EMI/EMC Testing	20	12 MAY 03	06 JUN 03	4d
CNNW1690	Mechanical Testing	20	09 JUN 03	07 JUL 03	4d
CNNW1700	Thermal Vacuum Testing	20	08 JUL 03	04 AUG 03	4d
CNNW1710	Mass Properties Verification	2	05 AUG 03	06 AUG 03	4d
CNNW1720	Mission Performance Functional Verification	36	07 AUG 03	26 SEP 03	4d
CNNW1730	Ship to VAFB	6	29 SEP 03 *	06 OCT 03	4d
VAFB Launch Operations					
		19	07 OCT 03	31 OCT 03	0
CNNW1750	Space Vehicle Post-Ship Func Test	3	07 OCT 03	09 OCT 03	4d
CNNW1790	Launch Vehicle Mating	1	10 OCT 03	10 OCT 03	4d
CNNW1770	Space Vehicle Post-Mate Func Test	3	13 OCT 03	15 OCT 03	4d
CNNW1780	Space Vehicle Aliveness Test	1	16 OCT 03	16 OCT 03	4d
CNNW1800	Launch Vehicle Mate to Aircraft	1	22 OCT 03	22 OCT 03	1d
CNNW1810	Combined Systems Test	1	23 OCT 03	23 OCT 03	1d
CNNW1830	Captive Carry to Alcantara	1	27 OCT 03	27 OCT 03	0
CNNW1840	SV Func Aliveness Test	1	28 OCT 03	28 OCT 03	0
CNNW1850	Combined Systems Test	1	29 OCT 03	29 OCT 03	0
CNNW1860	Mission Countdown and Rehearsals	1	30 OCT 03	30 OCT 03	0
CNNW1863	CNOFS/CINDI LAUNCH	1	31 OCT 03	31 OCT 03	0
CINDI NASA Review Support					
		9	07 OCT 03	17 OCT 03	43d
CNA11089	Launch Readiness Review @ VAFB	1	07 OCT 03	07 OCT 03	5d
CNA11092	Flight Readiness Review @ VAFB	1	17 OCT 03	17 OCT 03	43d



PROJECT MANAGEMENT -
RISK MANAGEMENT

CINDI CONTINUOUS RISK MANAGEMENT PLAN (CRM)

(CINDI Plan based on GSFC plan)

- Risk Identification
    - Full team participation
    - All project elements and phases
    - Formulate risk statements
- Risk Assessment
- Risk Planning
    - Research
    - Accept
    - Watch
    - Mitigate
- Risk Monitoring
- Risk Handling
    - Control
    - Communication/documentation

CINDI CRM
RISK ASSESSMENT

- Risk Assessment
  - Assess likelihood of occurrence
  - Assess consequence to the project
  - Classify (score) risk

RISK CATEGORIZATION

LIKELIHOOD (P)		1 Marginal (LOW)	2 Critical (MEDIUM)	3 Severe (HIGH)
Very Likely (HIGH)	3	4	5	6
Probable (MEDIUM)	2	3	4	5
Improbable (LOW)	1	2	3	4

CONSEQUENCE (C)

C + P = (score)

CINDI CRM
RISK MONITORING

- Continuous assessment of risk reduction
- Track mitigation effectiveness
- Ensure risk retirement/acceptable mitigation

CINDI RISK WATCH LIST

RISK NUMBER	RISK NAME	RISK OWNER	RISK DESCRIPTION	MITIGATION PLAN	SCORE		TIME FRAME
					W/O MITIGATION	W/ MITIGATION	

CINDI CRM
RISK HANDLING

- Risk Handling
  - SE is the focal point for technical risk management
  - PM manages schedule and cost risk
  - Risk Management Board (RMB)
    - Meets at least monthly
    - PM, SE, RQA, GSE, Mechanical, Electrical, Science/Software Representatives
  - RMB Actions
    - Continue current mitigation plan
    - Review/revise watch list
    - Re-plan
    - Close risk
    - Invoke a contingency plan

TOP FIVE RISKS

RISK RANK	RISK NAME	RISK OWNER	RISK DESCRIPTION	MITIGATION PLAN	SCORE W/OUT MITIGATION	SCORE W/ MITIGATION
1	Schedule-Documentation and Review Requirements	PM	NASA documentation and review requirements could overload manpower effort of key personnel at critical times resulting in a schedule slip.	1. Carefully consider value and impact of added documentation and/or changes to UTD traditional approach in light of required delivery date. 2. Delay delivery of documentation to the extent permitted. 3. Obtain SwRI Assistance. 4. Hire experienced RQA engineer. 5. Develop resource loaded schedule. 6. Subcontracted PRA effort.	2+2=(4)	2+1=(3)
2	Schedule - Late Flight Parts Delivery	PM	Long lead times for parts delivery could cause a schedule slip.	1. Long lead parts identified and ordered. 2. Procure work-around parts. 3. Use existing inventories 4. Facilitate timely NASA funding. 5. Begin test cycle with low-rel part, replace with Hi-rel, retest as required.	2+2=(4)	2+1=(3)
3	Multiplier Failure	SE	Multiplier failure causes loss of RWS data.	1. Use mechanically robust multiplier. 2. Do early vibration test 3. Use long lifetime multiplier. 4. Provide clean vacuum environment during test and flight. 5. Dry nitrogen backfill during integration/testing.	2+2=(4)	2+1=(3)
4	Filament Failure	SE	Filament failure causes loss of RWS or XTRK data.	1. Provide redundant filaments. 2. Use soft start circuit for filament heat. 3. Current limit filament heat output. 4. Use long-life with high efficiency to reduce heat. 5. Do early performance/validation tests. 6. Use minimum required emission current. 7. Provide filament disable plug for protection during ground test. 8. Performed extensive filament lifetime analysis.	2+2=(4)	2+1=(3)
5	PE Valve Failure	SE	PE Valve failure results in inability to equalize pressures in NWM sensor pressure chambers.	1. Use solenoid design with minimal moving parts. 2. Spring load to closed position. 3. Use dry lubricant on solenoid plunger. 4. Life test and early vibration test.	2+2=(4)	1+1=(2)

DESCOPE OPTIONS

DESCOPE OPTION	SCIENCE IMPACT
1. Give NWM priority over IVM	1. None, Possible late IVM delivery
2. Descope(remove) RPA	2. 20% loss, min. C/NOFS impact
3. Descope(remove) IVM	3. 30% loss, min. C/NOFS impact
4. Descope(remove) CTS	4. 50% loss, substantial C/NOFS mission impact

DESCOPE PROCESS LINKAGES

- Technical – no state-of-the art items, prior instrument development/test
- Budget - well funded with margin during critical time periods
  - Facilitates possibility of offloading to outside subcontractor
  - Facilitates possibility of acquiring additional personnel resources
- Conclusion - Descope considerations most likely triggered by schedule issues

DESCOPE/SCHEDULE LINKAGE

TRIGGER	POSSIBLE ACTIONS
• Schedule slippage on subsystem critical path for delivery to next assembly for 2 consecutive reporting periods or total negative float > 10 days	• Identify problem • Descope subsystem where possible • Augment staffing • Move work to outside vendor • Implement descope option 1
•Schedule slippage on subsystem critical path for delivery to next assembly for 2 consecutive reporting periods or total negative float > 20 days	•Implement descope options 2, 3, or 4 as appropriate

Descope options executed with concurrence of both the NASA & C/NOFS project offices

PROBABILISTIC RISK ASSESSMENT - PRA

- PRA performed by Aerospace Corp.
- GSFC contract direct to Aerospace
- PRA analysis of all of CINDI hardware
- Does not include PRA analysis of C/NOFS spacecraft or mission

PRA OBJECTIVES

- Identify most critical CINDI components
- Rank mission critical components according to risk contribution
- Estimate likelihood of CINDI success per PRA

PRA SCHEDULE

- Functional FMEA 30 Nov 01
- Develop and quantify PRA models
  - Preliminary results by 30 Nov 01
  - Final completed by 31 Jan 02
- Identify and rank main risk contributors
  - Preliminary results by 15 Dec 01
  - Final completed by 28 Feb 02

PROJECT MANAGEMENT - REVIEW PROCESS

PEER REVIEWS

- In-house UTD reviews
    - Reviews of subsystems and instruments
    - Experienced scientists and engineers
- Air Force and Spectrum Astro reviews of NWM & IVM
- GSFC will enlist discipline experts to review circuit designs of NWM & IVM

MILESTONE REVIEWS

• Phase A Report Review	10 May 01
• Air Force PDR	31 Jul 01
• NASA PDR	28 Aug 01
• NASA Confirmation Review	29 Aug 01
• Air Force CDR	29 Nov 01
• NASA CDR	Dec 01
• Pre-Environmental Review - IVM	Aug 02
• Pre-Ship Review - IVM	Aug 02
• Pre-Environmental Review - NWM	Sept 02
• Pre-Ship Review - NWM	Oct 02
• Ground Operations Review	Jan 03
• Flight Readiness Review	Oct 03

UTD ACTION ITEMS FROM REVIEWS 1

UTD In-House Peer Reviews

- Perform early vibration of multiplier assy - Nov 01
- Include dry nitrogen backfill for NWM - CLOSED
- Enlist SwRI to provide documentation jump-start - CLOSED
- Utilize redundant filaments in RWS and XTRK - CLOSED
- Current limit filament heat - CLOSED
- Perform detailed analysis and literature investigation on filament lifetime - CLOSED
- Perform early performance/validation tests of filament - Sept 01
- Provide range of emission to operate filament at minimum required emission on orbit - CLOSED
- Investigate and convert to solenoid instead of motor in XTRK sensor - CLOSED
- Perform early vibration and accelerated life test on solenoid assy - Nov 01

UTD ACTION ITEMS FROM REVIEWS 2

Phase A Report Review

- Check lead-time of tantalum capacitors - CLOSED
- Work with NASA IV&V facility to produce letter for NASA HQ - CLOSED
- GSFC to provide UTD with Interpoint Converter information - CLOSED
- Investigate Aerospace support to perform PRA - CLOSED

Air Force PDR

- Perform magnetic measurements of RWS source magnet - 15 Sept 01
- Provide updated EMI/EMC data from spec sheets on internal instrument components - CLOSED
- Provide minimum bend radius for NWM S/C I/F cables - 15 Sept 01
- Provide drawings/definition of NWM safing screw and alignment mirrors - CLOSED
- Provide cleanliness requirement for SV thermal vac chamber - CLOSED

INTERFACE CONTROL DOCUMENTS

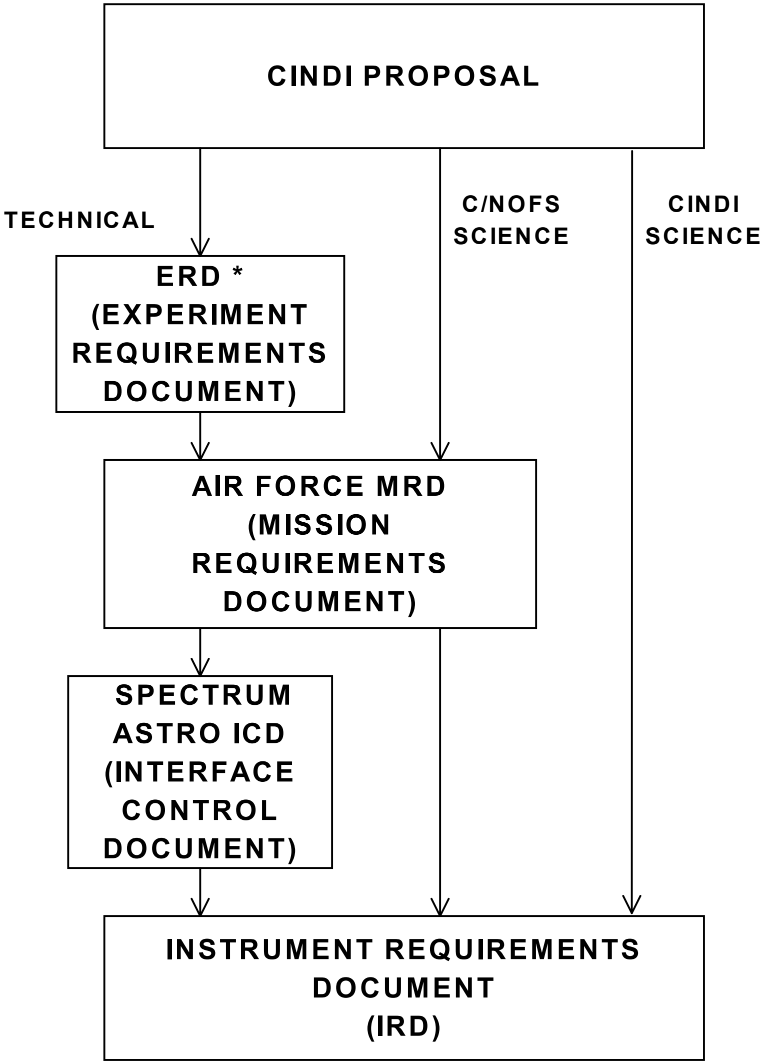
- Current - Draft ICDs are under Spectrum Astro configuration management/revision control
- 24 Sept 01 (after Mission PDR) - AFRL and UTD sign preliminary ICDs
- Mid-December 01 - Final ICDs signed by all parties (AFRL, UTD, STP, Spectrum)

SYSTEMS ENGINEERING

SYSTEMS ENGINEERING

- UTD Systems Engineer(SE) is responsible for all instrument performance and interface requirements and verification
- SE tracks technical resource (mass,power,TM,etc) utilization/margins as allocated in the ICD
- SE was on C/NOFS S/C Source Selection Advisory Board – familiar with C/NOFS S/C, instrument accommodation and interface issues
- SE tracks instrument performance and interface progress/status via the following:
    - Daily interaction with UTD team members
    - Weekly UTD team meetings
    - Weekly C/NOFS IPT telecon
    - In-house reviews of instruments/subsystems
    - Frequent communication with C/NOFS SE and S/C contractor

CINDI REQUIREMENTS FLOW DOWN



NOTES:

1. ICD & Instrument Requirements Document contain verification matrices
2. IRD specifies instrument measurement requirements
3. ICD controls all instrument/spacecraft interfaces and allocates resources
4. MRD controlled by Air Force
5. ICD controlled by Spectrum Astro
6. IRD controlled by UTD

* not maintained

SCIENCE MEASUREMENT REQUIREMENTS

PRIMARY MEASUREMENTS

Source: CINDI Proposal and C/NOFS Science

Parameter	Dynamic Range	Accuracy
1. Ion Drift Vector	-500 m/s to +500 m/s	± 2 m/s
2. Neutral Wind Vector	-500 m/s to + 500 m/s	± 10 m/s

SECONDARY MEASUREMENTS

Source: C/NOFS and CINDI Science

Parameter	Dynamic Range	Accuracy
3. Total Ion Concentration	50 to $5x10^6$ cm^{-3}	1%
4. Ion Temperature	500 to 7000 K	50 K

MEASUREMENT ENVIRONMENT

PARAMETER	DYNAMIC RANGE
5. Total Ion Concentration	50 to 5×10^{6} cm^{-3}
6. Ion Mass Range	1 to 32 amu
7. Ion Temperature	500 to 7000 K
8. Total Neutral Concentration	6×10^{6} to 6×10^{8} cm^{-3}
9. Neutral Mass Range	4 to 16 amu
10. Neutral Temperature	500 to 4000 K

FLOW DOWN REQUIREMENTS
ENGINEERING MEASUREMENTS

Source #	Parameter	Value
3,5	**RPA Current Range**	3×10^{-11} to 3×10^{-6} A
3	**RPA Current Accuracy**	1 %
6,7	**Max RPA R.V.**	19 V
1,4	**RPA R.V. Accuracy**	3 mV
1,5	**IDM Current Range**	5×10^{-12} to 6×10^{-7} A
1	**IDM Max Current Ratio**	1.2
1	**IDM Curr Ratio Resolution**	1.0003
8,10	**RWS Current Range**	4×10^{-12} to 4×10^{-9} A
8,9,10	**Max RWS R.V.**	10 V
2,10	**RWS R.V. Accuracy**	7 mV
2,8,10	**XTRK Current Range**	3×10^{-12} to 3×10^{-9} A
2	**XTRK Max Current Ratio**	1.1
2	**XTRK Current Ratio Resolution**	1.0005

REQUIREMENTS DOCUMENTATION

- Instrument Requirements Document(IRD) - documents instrument science and engineering measurement requirements, flowdown, dynamic range, accuracy - contains verification matrix
- Instrument ICD – captures all interface requirements , resource allocation and margins, and environmental test/verification requirements for each instrument - contains verification matrix

IVM/NWM ENVIRONMENTAL TESTING

- Thermal Cycles
  - 8 Cycles
  - -24C to +61C
- Random Vibration
  - 9.0 GRMS
  - 140 seconds
  - Protoflight levels per ICD
- Pyroshock (1 shock per axis)
  - Protoflight Levels (2000 peak g) per ICD
- Thermal Vacuum
  - 8 Cycles
  - -24C to +61C (operation)
  - -34C to +71C (survival)
- EMI/EMC
  - Internal SC Bus per ICD
- Test sequence follows ICD
- Magnetic induction test
- Test procedures will be written by UTD or by test vendors with UTD input and approval

ENGINEERING ACTIVITY COMMONALITY

- Thermal control scheme and limits
- Spacecraft mounting scheme
- Alignment method/requirements
- 1553 data and command interface
- Power interface
- Contamination control requirements

VERIFICATION

INSTRUMENT PERFORMANCE REQUIREMENTS VERIFICATION

- IRD Requirements Verification
  - Science/Measurement Environment Flowdown
    - Verified by analysis
  - Engineering Measurements
    - Verified by test
- IRD Requirements Verification Performed at UTD
  - Flowdown analysis complete by CDR
  - Engineering measurement test/verification during End Item Tests at UTD

Complete Verification Matrix Contained in IRD

INTERFACE/ENVIRONMENTAL VERIFICATION

- ICD Requirements Verification
  - Physical – Analysis, Inspection
  - Alignment – Test
  - Structural - Test
  - Electrical – Test
  - Signal – Test
  - Thermal – Analysis, Test
  - EMI/EMC – Test
  - Magnetic Induction – Test

THESE TESTS ARE PERFORMED DURING INSTRUMENT ENVIRONMENTAL TESTING, INTEGRATION TESTING WITH THE PAYLOAD MODULE, AND INTEGRATION TESTING WITH THE SPACECRAFT

Complete Verification Matrix Contained in ICD

VERIFICATION METHODS

a. **Analysis** - This approach is used to verify compliance to requirements, which are not readily verified by other means. Examples include payload pointing accuracy, and reliability. Tools of this verification method include math models, simulations, compilation, and extension of test results.

b. **Demonstration**- This approach is used to illustrate an end-item compliance to requirements by direct observation of the end-item operation. (Example: 1553B bus operation).

c. **Inspection**- This verification approach is used to verify compliance to requirements through examination of the physical characteristics, visual properties, design schematics, etc., without the use of special laboratory tools, procedures, or services. Common examples are identification, size, weight, dimensions, cleanliness and documented records.

d. **Test**- This verification approach is used to verify compliance to requirements through functional measurements, such as voltage levels and pulse width characteristics. This common verification method generally requires special laboratory equipment, detailed procedures, manual or automated data recording, etc.

PERFORMANCE ASSURANCE

PERFORMANCE ASSURANCE
KEY INDIVIDUALS 1

R.A. Heelis, WBH-CSS Director

- Center "CEO" has ultimate responsibility for ISO 9001 implementation

L.L. Harmon, WBH-CSS Quality Management System Representative

- Reports directly to Director
- Responsible for WBH-CSS quality system oversite (delegated from Director)
- Internal/external audits
- Responsible for WBH-CSS safety plan oversite
- ISO training

L.D. McCullough, SwRI Product Assurance Manager/Specialist

- Under contract to WBH-CSS to generate ISO 9001-2000 consistent documentation for the Center

PERFORMANCE ASSURANCE KEY INDIVIDUALS 2

C.R. Lippincott, WBH-CSS Program Manager

- Oversees project performance assurance programs

R.E. Garcia, CINDI Product Assurance Manager

- Responsible for implementation of CINDI Performance Assurance Implementation Plan
- Responsible for implementation of WBH-CSS and Project Safety Plan
- Conducts project quality system audits
- Reviews project procurement quality requirements/documents
- Monitors product assurance documentation
  - Procedures
  - Travelers
  - Test reports
- Conducts training

PRODUCT ASSURANCE 1

- Extensive NASA/DoD experience
- PA plan based on past experience
  - Basic plan previously approved by NASA and DoD projects
    - AE, DE, San Marco, DMSP
  - Tailored for SMEX SRQA requirements
    - Appendix added to basic plan
- PA personnel participate in all program phases including procurement
- Consistent with ISO 9001
  - Contains key ISO 9001 elements

PRODUCT ASSURANCE 2

- Appendix added to base plan to cover SMEX SRQA requirements
- SMEX appendix overview
  - PI Responsibility
  - Continuous Risk Management
  - Subcontractors and Suppliers
  - Parts and Workmanship Quality
  - System Safety
  - Consistent with ISO 9001
  - Workmanship Standards
  - Assurance Audits and Reporting
  - Failure Reporting
  - Reviews
    - Peer Reviews
    - Semiformal/Formal Reviews
    - Red Team
  - Systems Safety Implementation Plan
  - Safety Data Package
  - EEE Parts Program
    - Parts Lists
    - GIDEP Reports
  - Materials and Processes Control
    - Materials Lists
  - Probabilistic Risk Assessment
  - Contamination Control
  - Software
  - Verification
  - Mission Ops/Reports

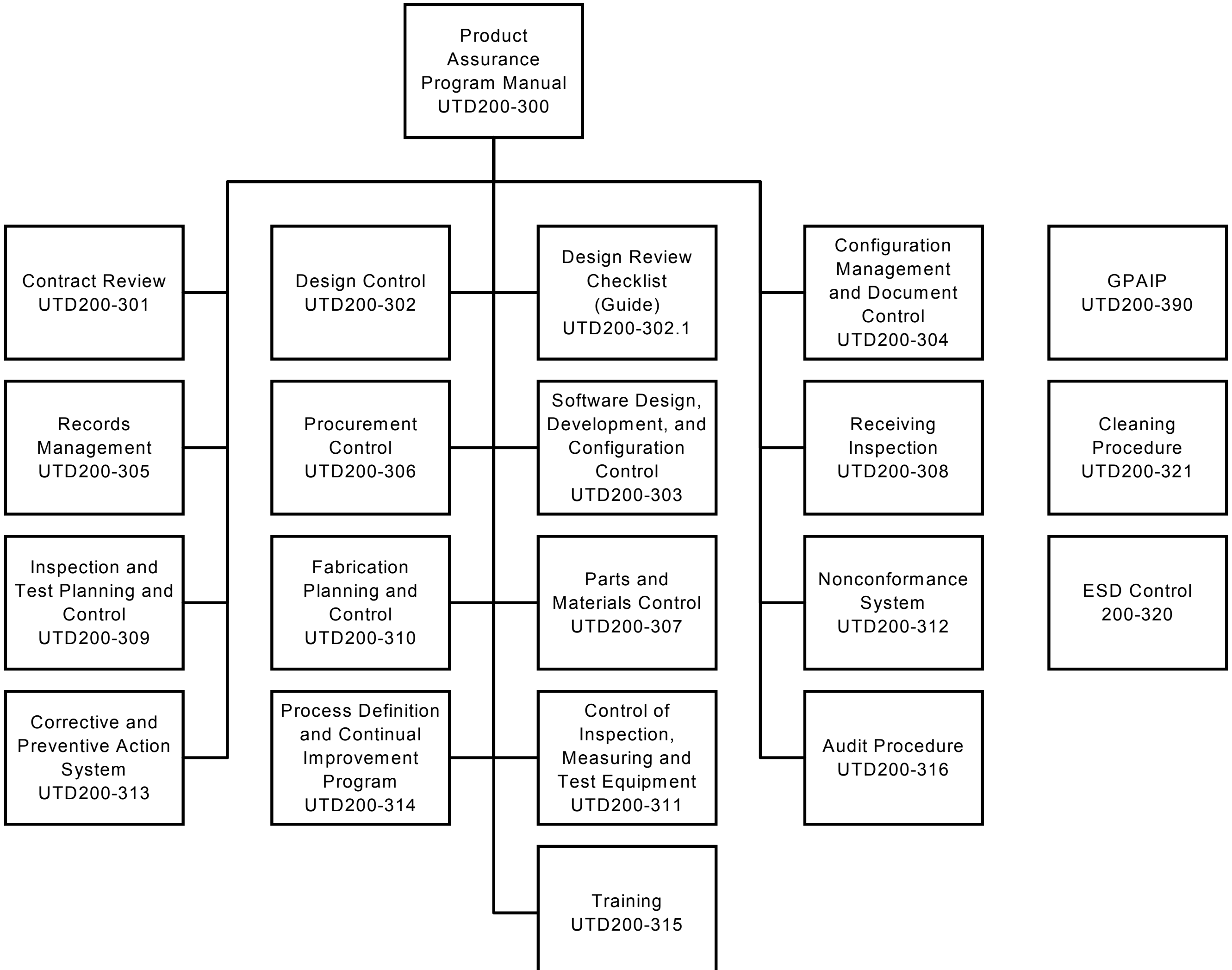
PRODUCT ASSURANCE 3

- UTD Base Plan used on previous successful NASA and DOD programs
- Base Plan Overview
    - Management
    - Procurement Requirements
    - Audits/Reviews
    - EEE Parts Control
        - Selection/PCB
        - Nonstandard Parts Approval
        - Application
        - Radiation Tolerance
        - Parts List
        - Traceability
        - Procurement Controls
        - GIDEP Reporting and Follow-up
    - Materials and Processes Control
        - Materials Lists
        - MRB
    - Drawing/Specification Control
    - Identification and Traceability
- Analyses
    - Electrical Derating/Stress
    - Radiation Tolerance
    - Reliability Prediction
    - Thermal
    - Structural
- Configuration Management
    - Approval by AFRL/NASA of Interface/Performance Changes from the MRD, ICD or CDR
- Document Change Control
- Procurement Requirements Control
- Nonconformance Control
- Malfunction Reporting to AFRL/NASA
- Fabrication/Workmanship Control
- Inspections and Tests
- Calibration of Test Equipment
    - Traceable to NBS
- Training/Certification of Personnel

CINDI PA PLAN COMPATIBILITY

- Plan satisfies NASA requirements and AFRL requirements with the following additions
  - Preliminary and final parts lists and materials lists
  - Hazards list
  - Safety contributions to mission safety document
  - Instrument environmental testing
  - MIL-STD-1540 temperature cycling requirements
  - Functional configuration audit

WBH-CSS DOCUMENT TREE



QUALITY FLOW-DOWN TO SUPPLIERS

- No major sub-contractors
- Quality requirements imposed on suppliers
  - Quality/reliability requirements on purchase documents
  - Source Control Drawings for unique components
- Audits of outside vendor capabilities and quality control
  - Machine shops
  - Plating facilities
  - Test facilities
- 100% in-house inspection of outside fabrication/plating
- Receiving inspection/traceability for all flight parts

CONFIGURATION CONTROL

- Drawings signed off - placed under control
- Latest issue of master drawings on central server
- Master drawings are read only on server
- Changes by engineering change order only
- Planning sheets (travelers) generated for fabrication & inspection
  - Each step signed by performer
- Single controlled drawing (shop copy) utilized for fab
- Planning sheet/controlled drawings document "as built" condition
- Documentation kept in controlled file

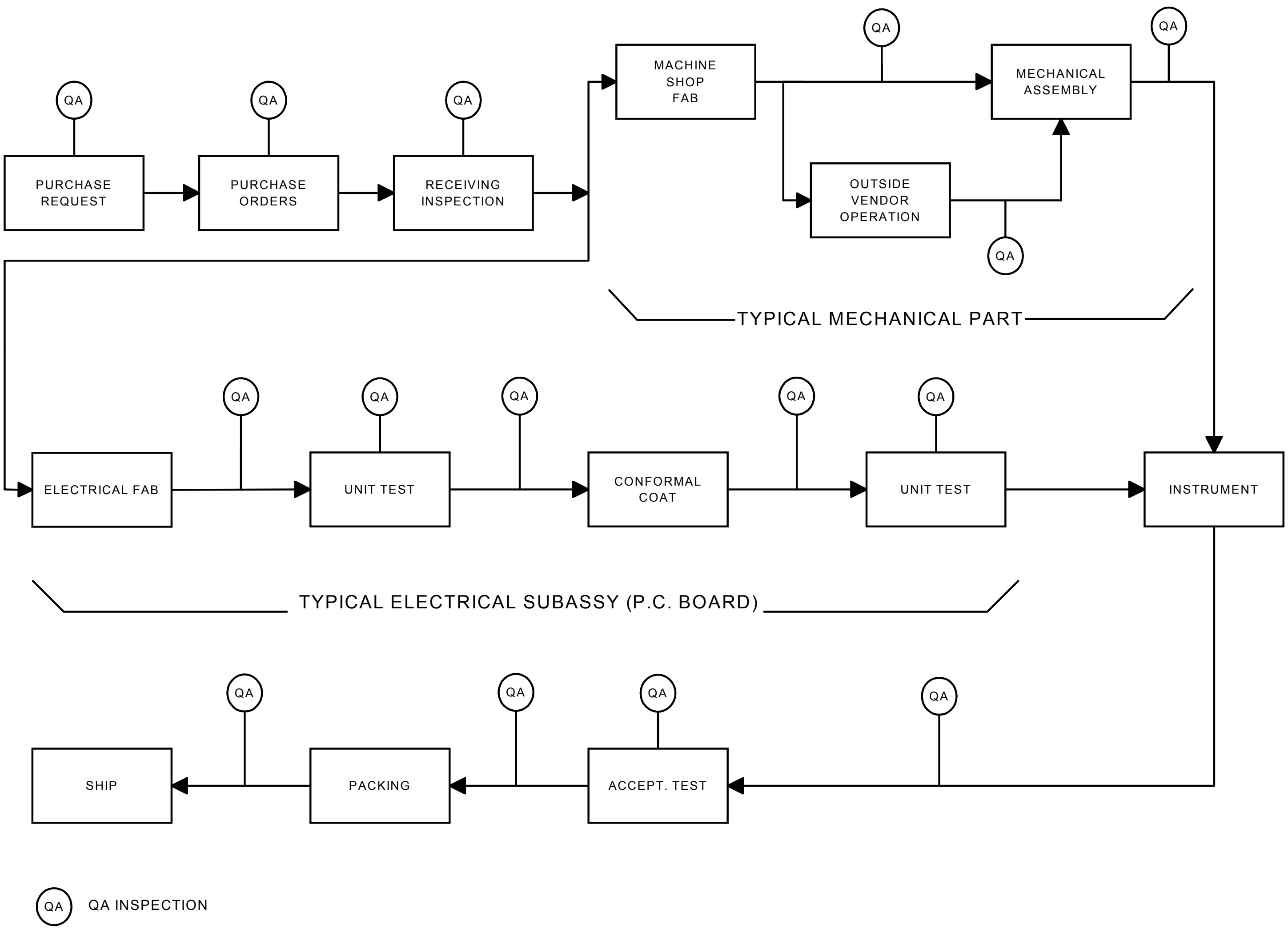
MANUFACTURING APPROACH

- 100% in-house design
- Drawing review and sign-off by responsible personnel including QA
- Planning sheets (travelers) and drawings released for fabrication by cognizant engineers and QA
- Blank boards and mechanical parts (including plating) fabricated by qualified outside vendors
- 100% in-house inspection
- Batch numbers (traceability) assigned to all purchased and fabricated parts/subassys
- Boards and parts cleaned and stored in controlled storage until needed for assembly

ASSEMBLY AND TEST APPROACH

- 100% in-house electrical and mechanical assembly and inspection
- Planning sheets utilized for control and record keeping (part/subassy batch numbers recorded)
- Controlled access assembly and test areas
- Trained/certified assemblers and inspectors
- Laminar flow benches utilized
- All workstations and equipment grounded
- ESD training and wrist straps utilized
- Special tools and test equipment calibrated
- In-house bench, vacuum and temperature testing
- Formal test procedures utilized/test data recorded
- In-process and final inspections
- Instrument environmental testing (vib., shock, TV, EMI, mag., etc.) accomplished at outside vendors
    - Environmental test procedures written by UTD and test vendor

TYPICAL WORK FLOW CHART



UTD FACILITIES AND EQUIPMENT

- CAD/CAM drafting and machine shop
- PWA inspection and assembly areas
- Controlled access assembly and test areas
- Laminar flow benches
- Oil free vacuum test chamber
- Electronic test and checkout equipment
- Custom designed ion/electron sources for sensor test
- Computational facilities
  - Laboratory & office computers
  - Dedicated UNIX cluster
  - Local supercomputers

CONTAMINATION OVERVIEW

- Moderate Sensitivity to NVR in selected areas
- Particulate contamination is of secondary concern
- Materials Selection and Vent Paths
- Cleanliness Emphasized During All Phases
  - Assy/Test Areas
  - Assembled Clean
  - White Glove Handling
- Oil-Free Vacuum Systems
- Personnel Training
- Project contamination control plan
- Extensive past successful experience utilizing the following procedures

UTD CONTAMINATION CONTROL PROCEDURES

- Materials selection/processes
  - NASA RP-1124 utilized: 1.0% TML, 0.1% CVCM
- Cleanliness emphasized during all phases
  - Critical sensor assemblies accomplished on laminar flow (HEPA filtered) benches
  - Other assembly/testing in controlled environment
  - "White glove" handling
  - Protective covers for sensor apertures
  - Backfill NWM sensors
  - Instrument protected when out of controlled environment
  - Selective cleaning operations
- Oil free vacuum systems for testing
  - Gold plated sensor aperture covers with venting through labyrinths
- Personnel Training
- Instruments kept under class 100,000 conditions
  - Assembly and test
  - Integration
  - Encapsulation and carry
- Instrument purging not required
- Red tags removed as late as possible
- Clean exposed gold plated surfaces after red tag removal (UTD personnel)

GENERAL I&T AND SV RECOMMENDATIONS/REQUESTS

- All parties utilize NASA RP-1124 for materials selection
  - 1.0% TML, 0.1% CVCM
- SV venting away from sensors
- "White glove" handling during all phases
- Class 100,000 integration and environmental test areas
  - > Class 100,000 - Protect in shipping container or bag
    - Bagging considerations
      - Tape lifting aeroglaze paint
      - Solvents attacking aeroglaze paint
- Oil-free, monitored vacuum systems
  - TQCM and cold finger monitors and pre-test certification
    - Empty chamber TQCM level < 300Hz/hour (for 3 hours) with chamber shroud at 100C using a 10MHz TQCM at -20C
    - No pump oil residue on cold finger
  - Gold plated covers over sensor apertures - labyrinth venting
- "Clean" launch vehicle faring
- "Clean" launch vehicle purge gas/air

IVM/NWM MATERIALS AND PROCESSES

- MIL-STD metal plating and finishing
- NASA RP-1124 utilized (1.0% TML, 0.1%CVCM)
- In-house processes and procedures well defined (listed in RQA plan)
- Non-magnetic materials
- Stress corrosion considered in metals selection
- Non-flammable or flame retardant non-metals
- Preliminary parts and materials lists have been submitted
- Processes controlled by written procedures

IVM/NWM MATERIALS LIST

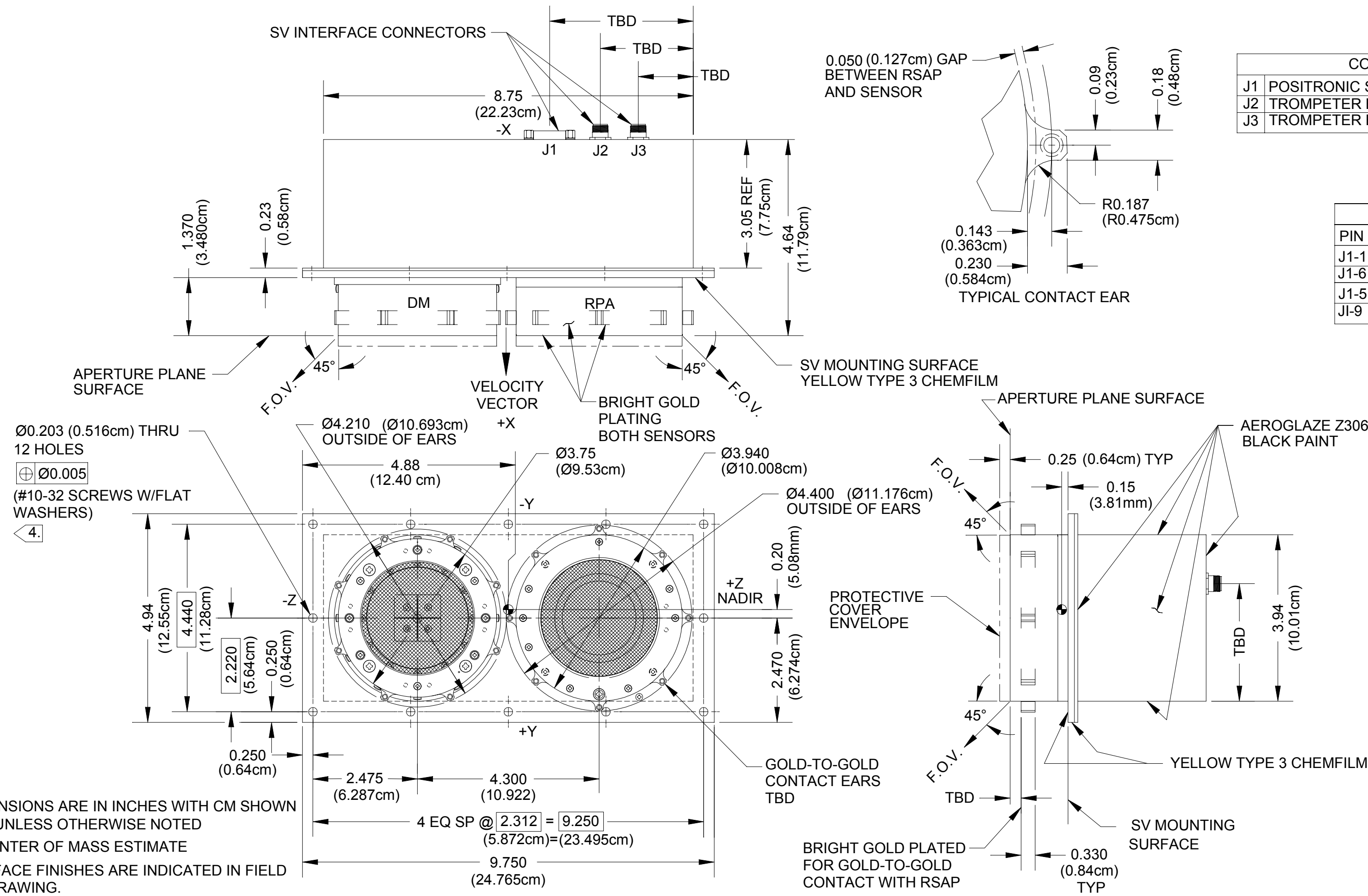
- Utilized past program experience
- NASA RP-1124 database used for outgassing info
- GSFC materials branch characterized "new Kel-F" (PCTFE)
- Preliminary materials list submitted
- Final materials list by CDR
- Have responded to C/NOFS hazardous materials list

SAFETY

- All safety info will be provided to AFRL/SA as required
- No heaters planned
- Enclosed volumes vented/no pressurized compartments
- No dangerous materials
- Materials selected using NASA RP-1124 and NHB 8060.1 as guidelines
- No explosive devices, non-explosive initiators or radioactive materials
- Connector mismate prevention achieved by keying/marking
- Handling fixtures not required
- Shipping cases designed to protect instruments from mechanical damage and contamination
- Instruments to remain in shipping cases when not on SV or in test
- Observe standard ESD precautions
- Connector savers utilized to prevent connector wear/damage
- Personnel training

INSTRUMENT OVERVIEW

ION VELOCITY METER OUTLINE/INTERFACE



CONNECTORS	
J1	POSITRONIC SND9M2000G (PWR/TLM)
J2	TROMPETER BJ3157
J3	TROMPETER BJ3157

J1 PIN / FUNCTION

PIN	FUNCTION
J1-1	+28 VOLTS
J1-6	+28 VOLT RETURN
J1-5	IVM TEMP (ANALOG TM)
JI-9	ANALOG TM RETURN

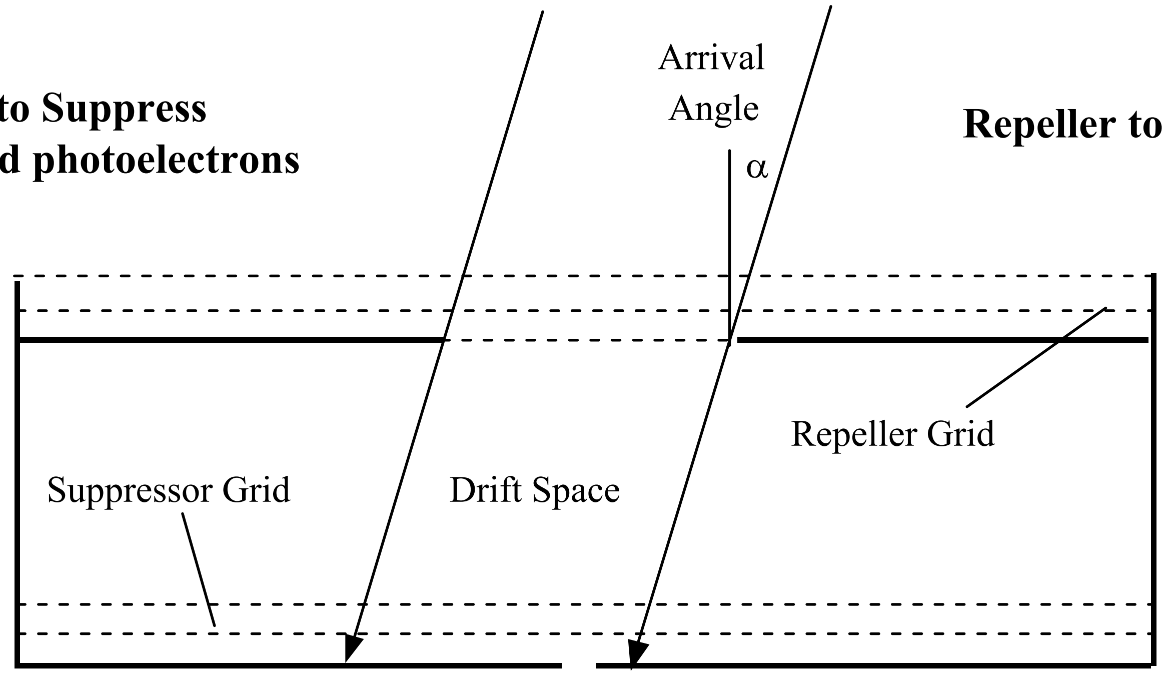
NOTES:

1. DIMENSIONS ARE IN INCHES WITH CM SHOWN IN () UNLESS OTHERWISE NOTED
2. CENTER OF MASS ESTIMATE
3. SURFACE FINISHES ARE INDICATED IN FIELD OF DRAWING.
4. LOCKING NUTS OR INSERTS IN SV- TORQUE 35 IN-LB OVER LOCK RESISTANCE.

DRIFT METER PRINCIPLES OF OPERATION

Suppressor to Suppress electrons and photoelectrons

Repeller to Suppress H+



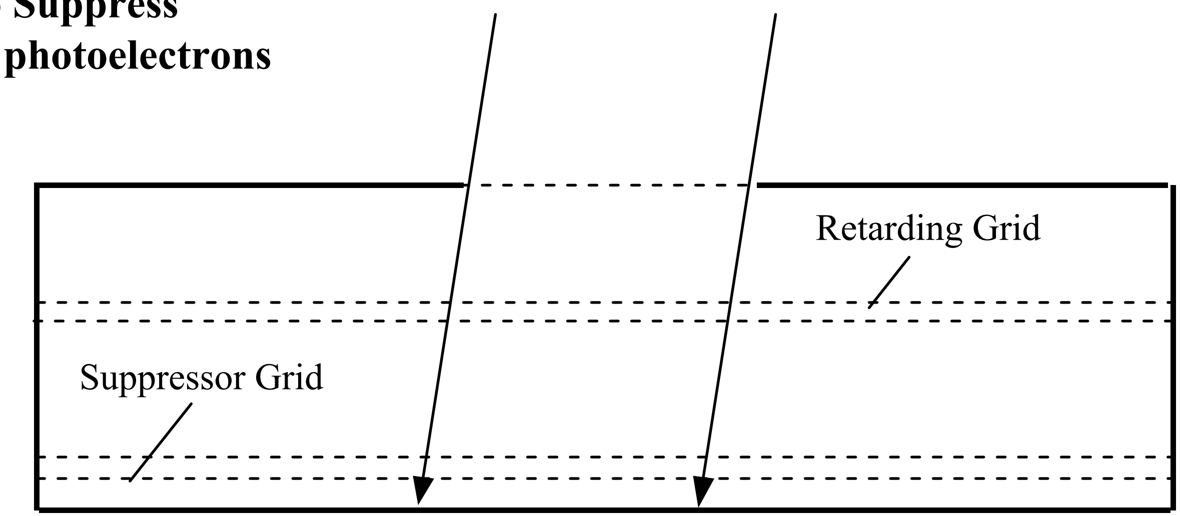
Supersonic Ions Form Beam behind Square Aperture

Split Collector Produces Collected Current Asymmetry

Ratio of Currents (Logarithm of Current Difference) proportional to Tan(α)

RETARDING POTENTIAL ANALYZER PRINCIPLES OF OPERATION

Suppressor to Suppress electrons and photoelectrons

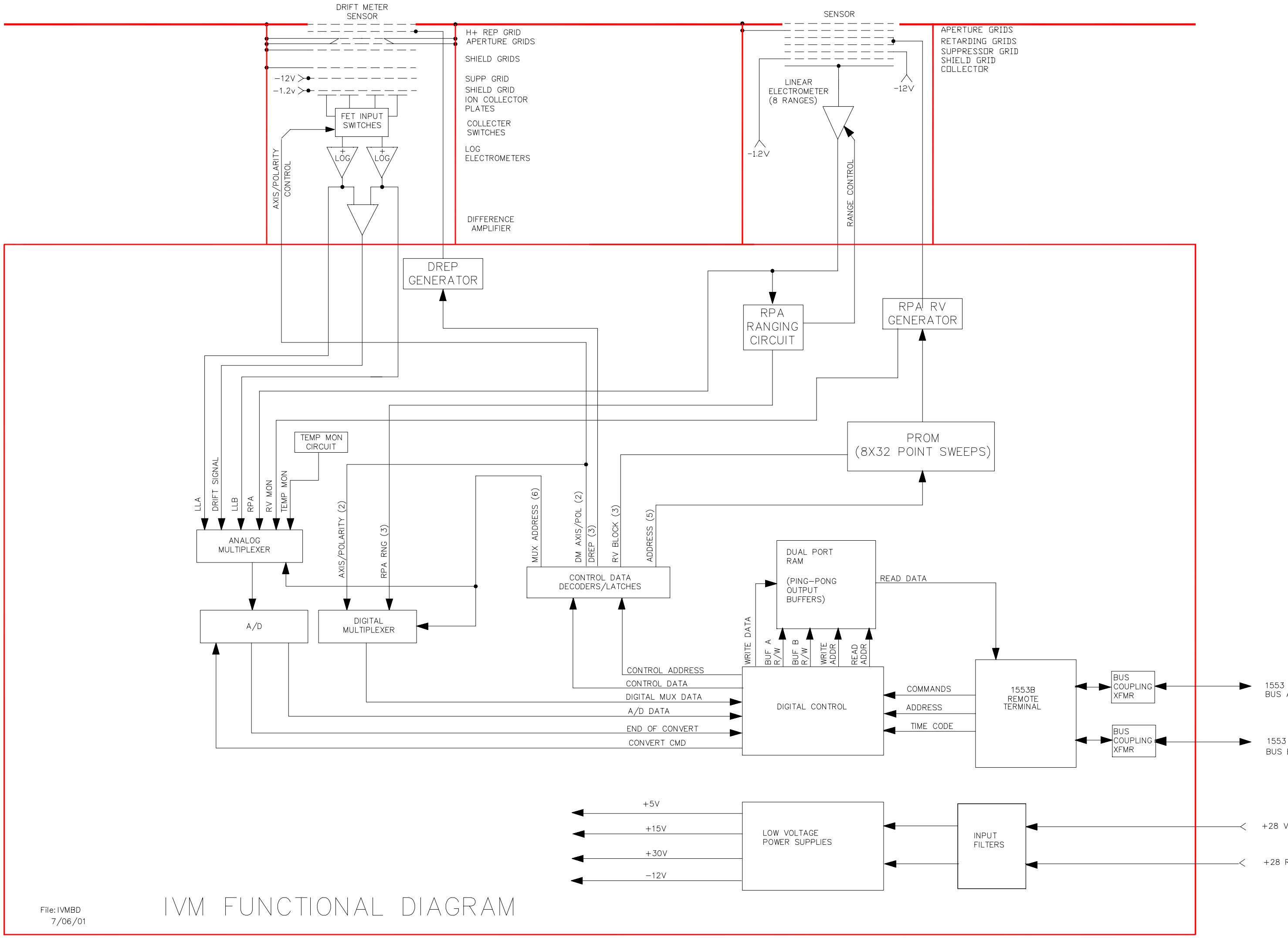


Retarding Grid Determines Kinetic Energy of Ions Having Access to the Collector

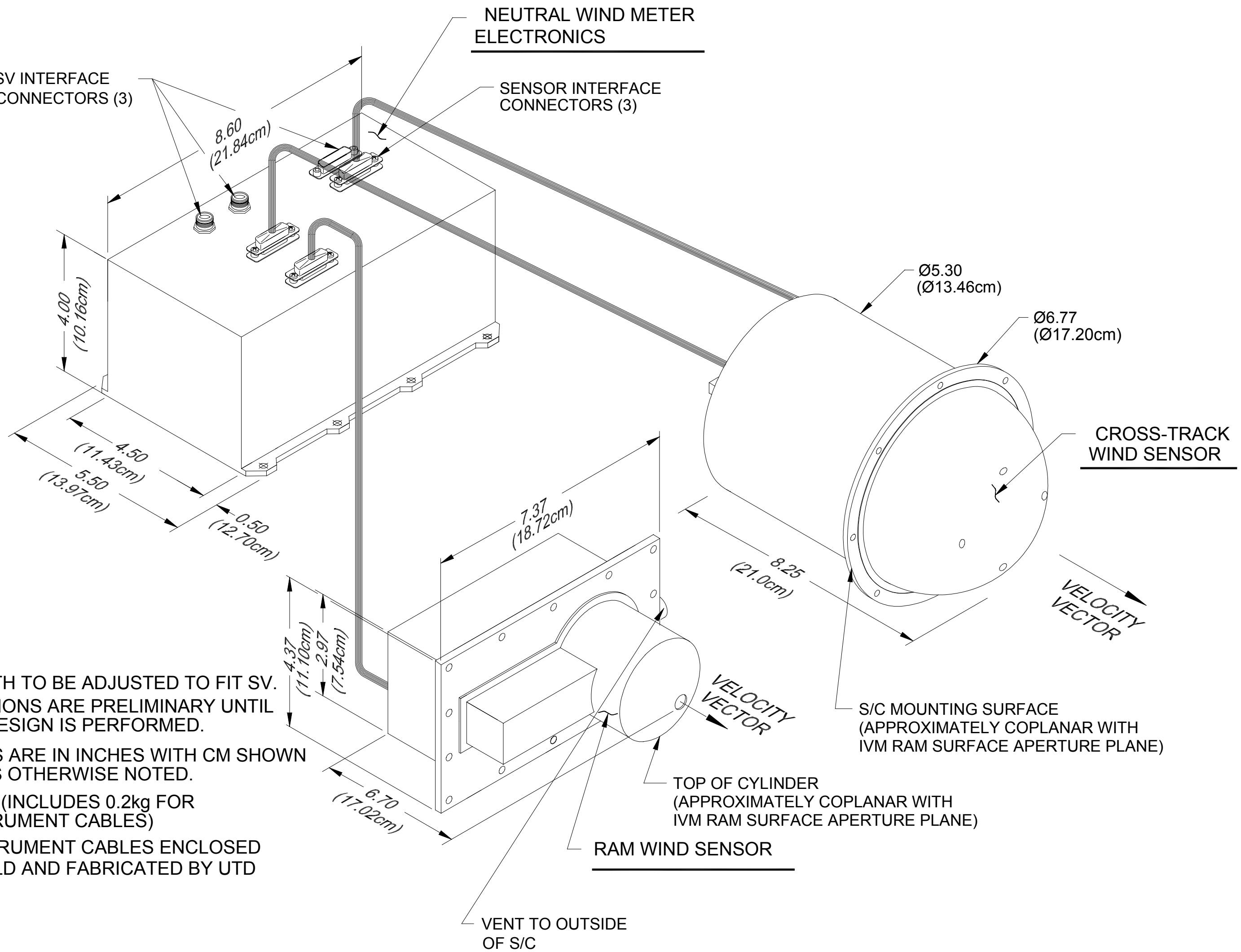
Collected Ion Current at a Given Retarding Potential is Dependent on Ion Mass ; Bulk Flow Velocity ; Temperature ; Aperture Plane Potential

Given the Mass Least Squares of Current vs Retarding Potential provides Bulk Flow Velocity ; Temperature ; Aperture Plane Potential

IVM FUNCTIONAL DIAGRAM



NEUTRAL WIND METER



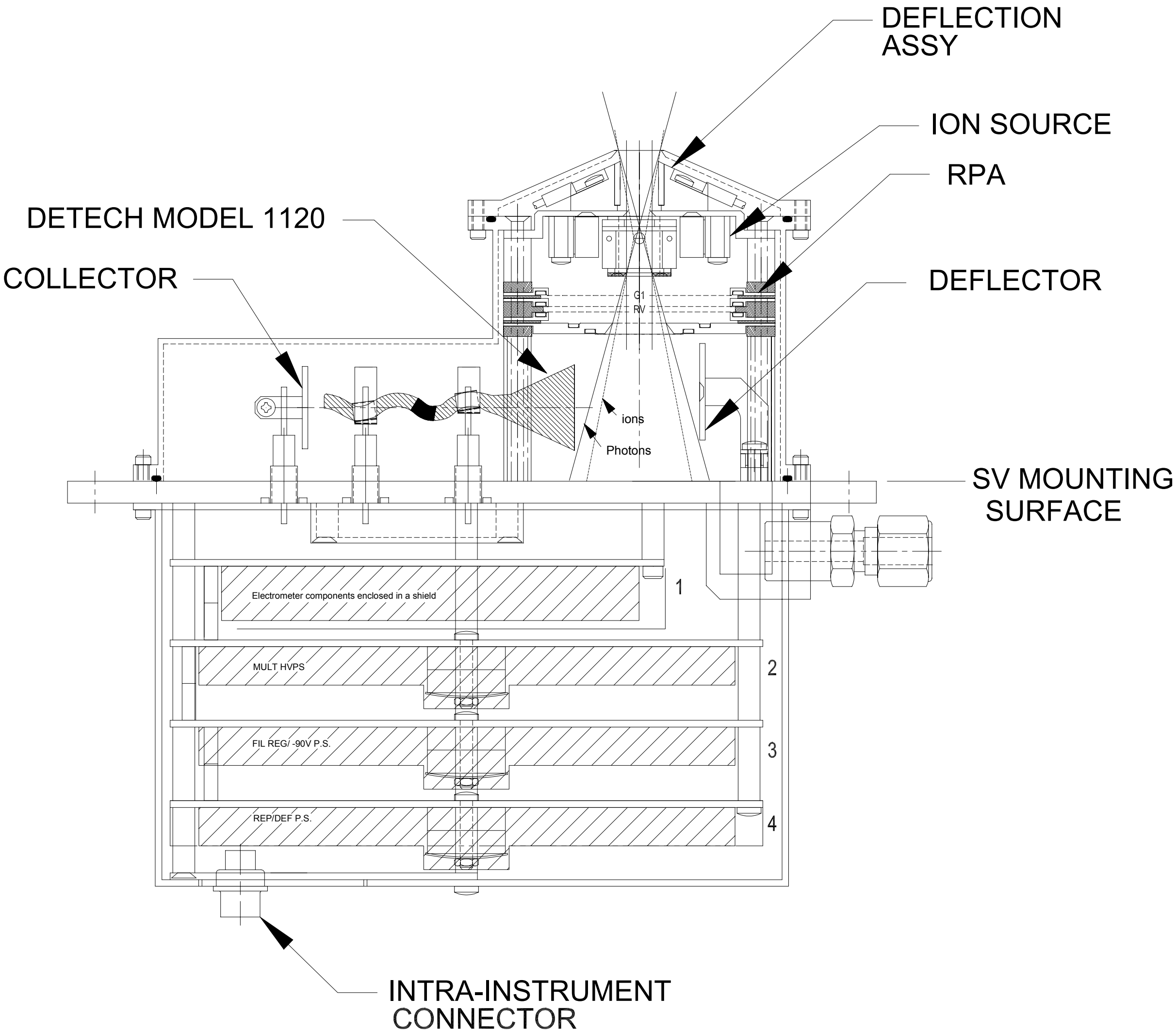
NOTES:

- VENT LENGTH TO BE ADJUSTED TO FIT SV.
- ALL DIMENSIONS ARE PRELIMINARY UNTIL DETAILED DESIGN IS PERFORMED.
- DIMENSIONS ARE IN INCHES WITH CM SHOWN IN () UNLESS OTHERWISE NOTED.
- MASS- 6.0kg (INCLUDES 0.2kg FOR INTRA-INSTRUMENT CABLES)
- INTRA- INSTRUMENT CABLES ENCLOSED IN EMI SHIELD AND FABRICATED BY UTD

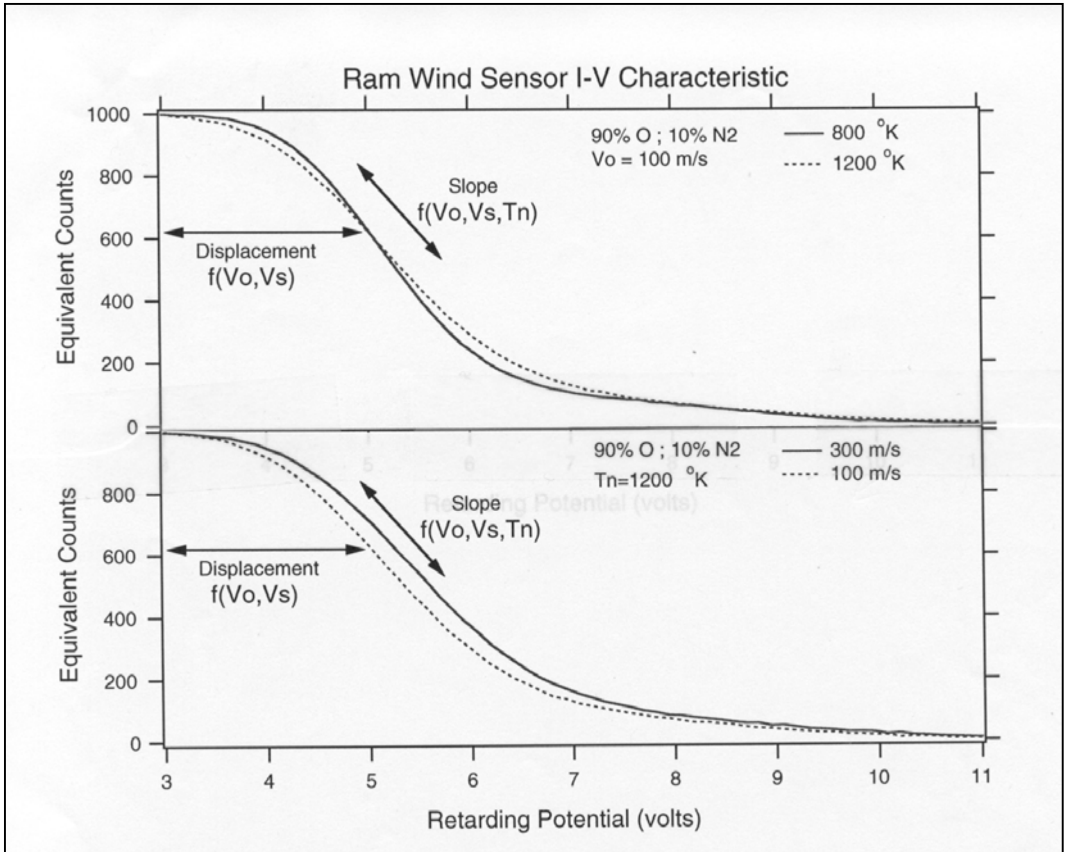
NEUTRAL WIND METER

- NWM measures three orthogonal components of the neutral gas velocity.
- These neutral wind components are coupled to the ion drifts and currents that trigger ESF irregularity growth.
- Ram sensor measures changes in ram kinetic energy, where $KE=\frac{1}{2}m(V_S+V_{RAM})^2$
- Cross-track sensor measures differential pressure between chambers, where $P_G=P_0[e \quad +\pi^{1/2}s(1+\mathrm{erf}(s))](T_G/T_0)^{1/2}$
- Chamber apertures are located on a dome such that pressure ratio in adjacent chambers is proportional to neutral arrival angle
- One vertical aperture pair, one horizontal pair

NWM RWS X-SECTION



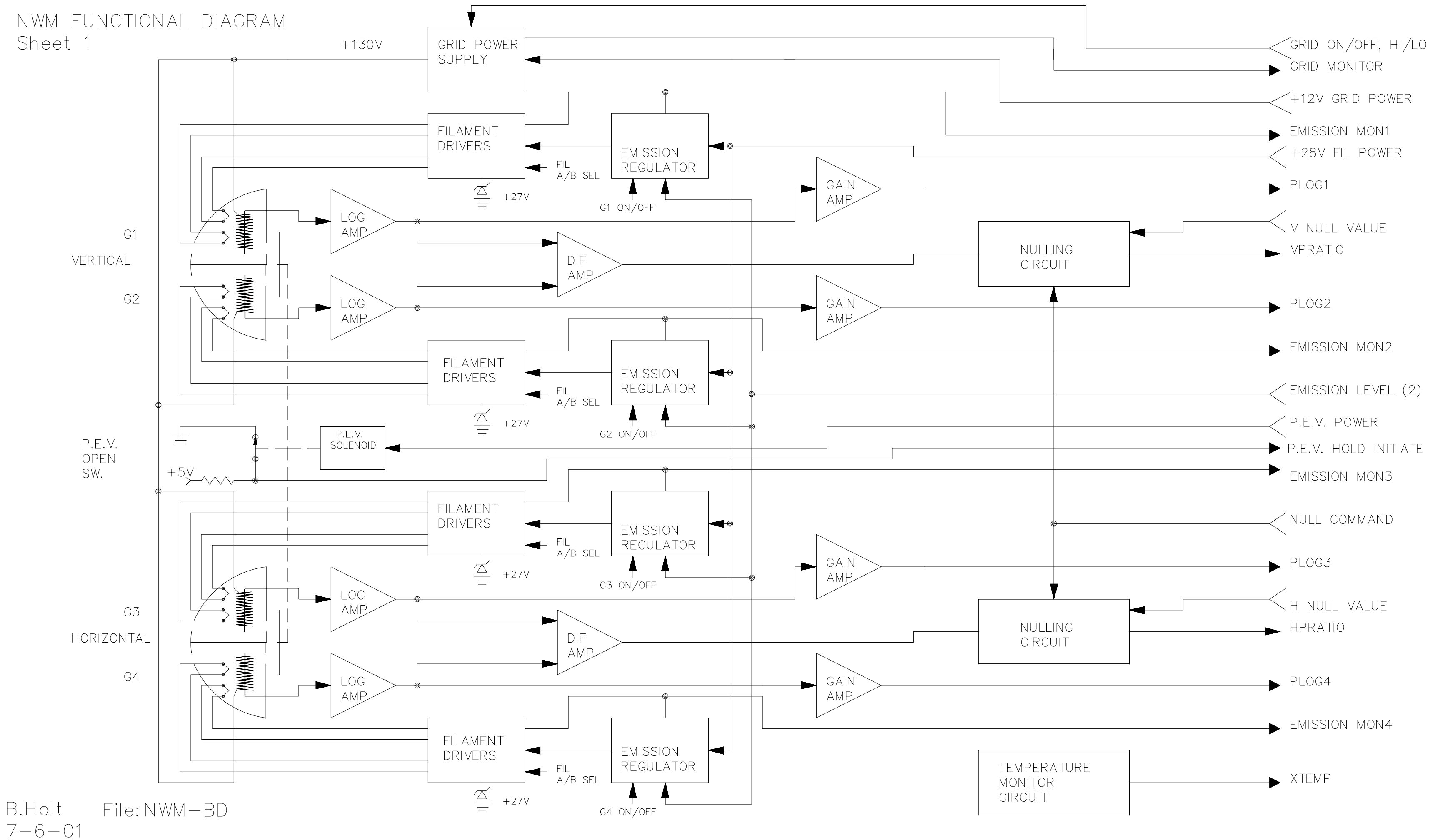
RAM WIND SENSOR I-V CHARACTERISTIC



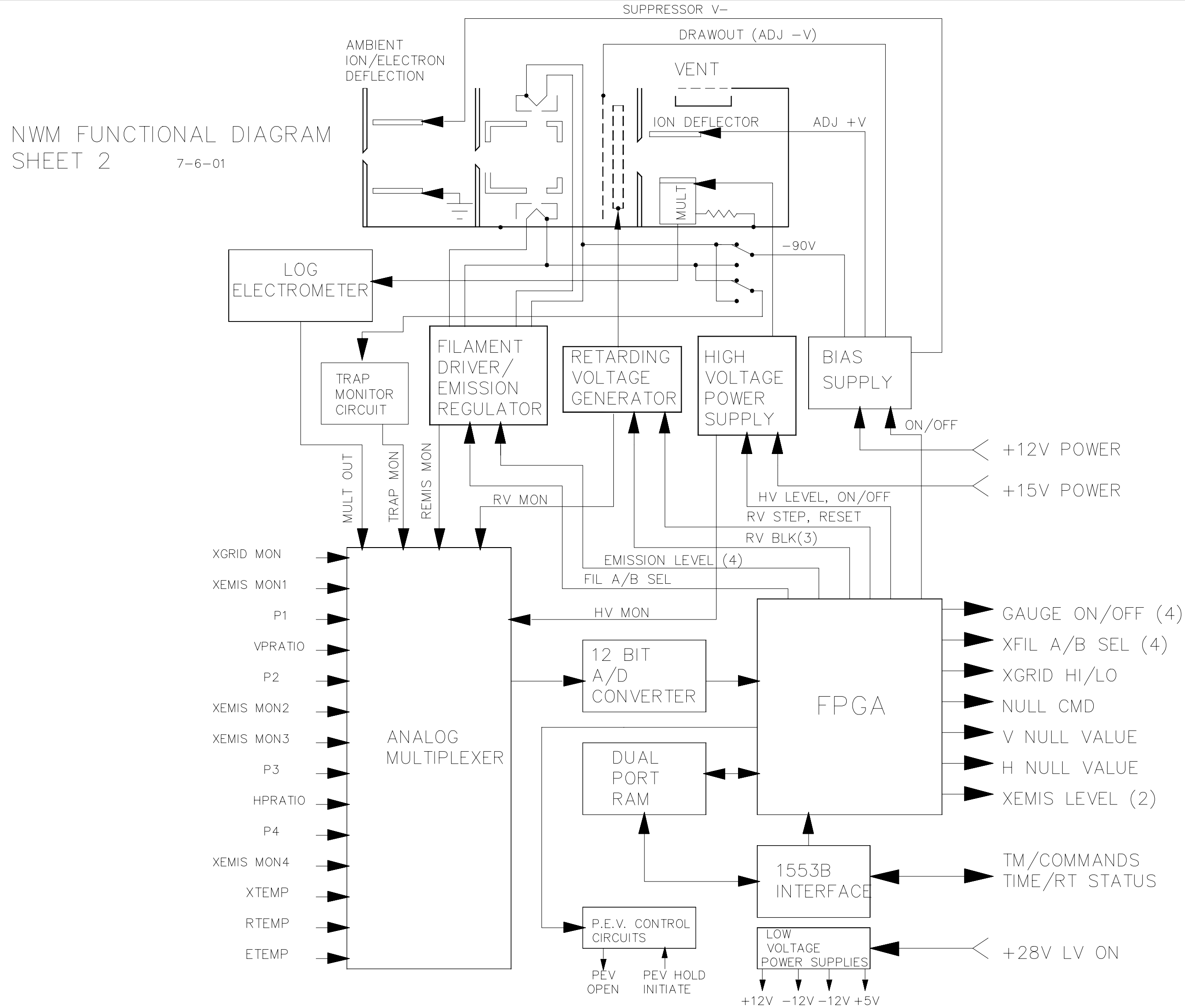
Effects of neutral gas temperature and ram velocity on collected ion current characteristic.

$$\boxed{KE=\tfrac{1}{2}m(V_S+V_0)^2}$$

NWM FUNCTIONAL DIAGRAM SHEET 1



NWM FUNCTIONAL DIAGRAM SHEET 2



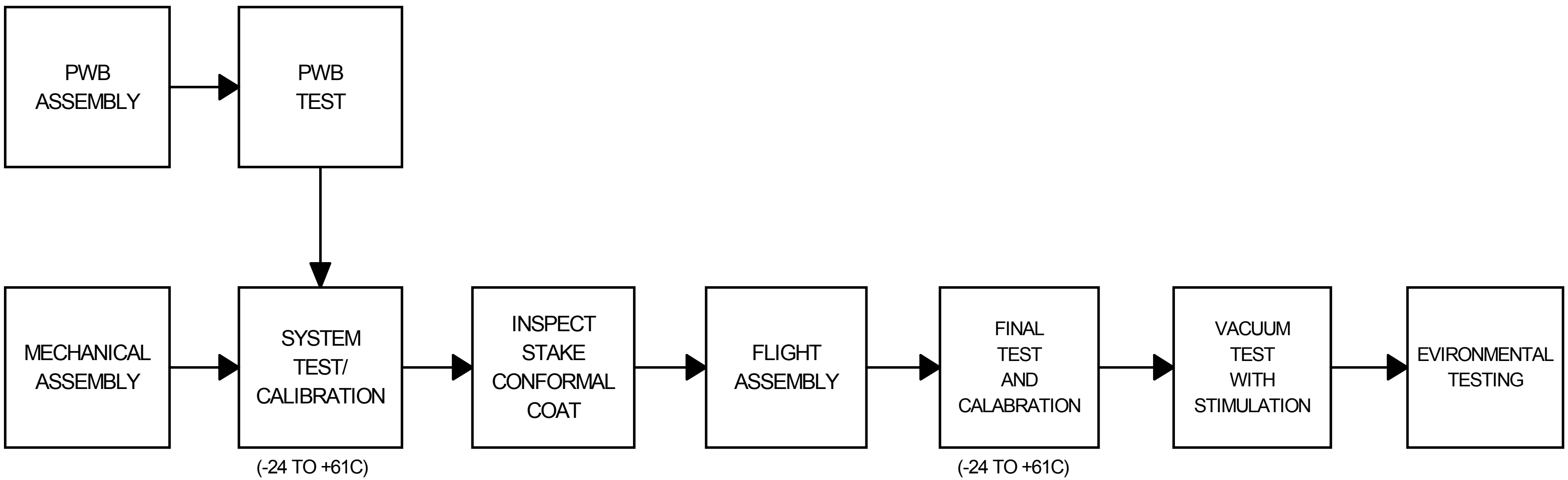
INTEGRATION AND TEST

INSTRUMENT TEST PLAN

- Individual PWB assembly tests over temperature
- Instrument test/calibration over temperature
    - Tests are designed to satisfy IRD verification matrix test requirements
- Functional tests in vacuum, ambient temperature, sensor stimulation with ion source/gas jet
- 200 hours minimum burn-in planned
- Instrument Environmental Testing
    - Tests are designed to satisfy ICD verification matrix environmental test requirements
- Integration with Payload Module at KAFB
- Payload Module integration with S/V at SA
    - Standard functional tests defined for payload module/SV testing

ASSEMBLY/INTEGRATION FLOW AT UTD

INSTRUMENT ASSEMBLY/INTEGRATION FLOW



INSTRUMENT ENVIRONMENTAL TEST FACILITIES

TEST	TEST FACILITY
• Thermal cycling	• UTD
• Vibration/shock	• SwRI
• Thermal Vacuum	• SwRI
• EMI/EMC	• SwRI
• Magnetics	• GSFC

Quotes obtained from the above test facilities indicate that the services/facilities should be available on the estimated dates required

S/C INTEGRATION SUPPORT

POST-DELIVERY SUPPORT

- **Instrument to Payload Module integration/testing at KAFB**
  - **UTD personnel present for initial integration, full functional test, stimulation/sensor grid test**
  - **Routine test data initially evaluated by AFRL personnel, then FTP to UTD for detailed evaluation**
- **Payload Module integration with S/C at Spectrum Astro**
  - **UTD personnel present for initial integration, full functional test, stimulation/sensor grid test**
  - **UTD personnel present for EMI/EMC, post-vib, TV, and final functional**
  - **UTD personnel perform sensor pump-out/backfill**
- **Launch site support**
  - **UTD personnel present for FRR, final functional, and red tag item removal**
  - **Routine data evaluation via FTP**
- **Early Orbit Checkout**
  - **UTD Personnel on-site at KAFB to participate in early orbit test plan execution**

FLIGHT OPERATIONS

FLIGHT OPERATIONS

Operations Overview

Optimized Workhorse Mode for IVM and NWS

IVM on all the time.

Slow offsets at selected local time/longitudes for Spread-F.

NWM on at altitudes below ~500 km

PE valve offset operation prior to perigee passes.

Operating Modes

a) Survey Mode

IVM Normal Mode.

IVM Slow Mode for some Spread-F studies

NWM Normal Mode Optimized for continuous operation through perigee.

b) Forecast Mode

IVM Normal Mode.

NWM Normal Mode Optimized for continuous operation through perigee.

c) Payload Burst Mode

No Special Operations

FLIGHT OPERATIONS

Special Operating Modes

a) Early Orbit Checkout

IVM Drift Meter Repeller Voltage for removal of H+ signal
IVM RPA retarding voltage sequence for ion composition
NWM RWS and CTS emission current for acceptable signal
NWM RWS ion source energy for acceptable signal
NWM RWS retarding voltage sequence for optimal signal
NWM CTS PE valve timing sequence for optimal signal.

Outgas NWM before HV/filament actuated

b) Campaigns

IVM RPA sweep rate and IDM offset rate can be maximized for specific objectives.

c) Backup modes and Anomaly Resolution

No redundant capabilities

FLIGHT OPERATIONS

On Orbit Calibrations

a) Internal Calibrations

- **IVM Drift Meter**
  - **Automatic Offset Sequence to remove electrometer offsets**
- **NWM CTS**
  - **Pressure Equalization valve to remove gauge offsets**

b) Satellite Calibrations

- **Slow s/c spin allows angular sensitivity of IDM, CTS and RWS to be determined**

c) Cross-Calibration with other instruments

- **E = -VxB allows comparison with VEFI**
- **IDM Ion Arrival Angles compare with DIDM**
- **RPA total ion concentration compares with PLP**

FLIGHT OPERATIONS

Day in the Life Operations

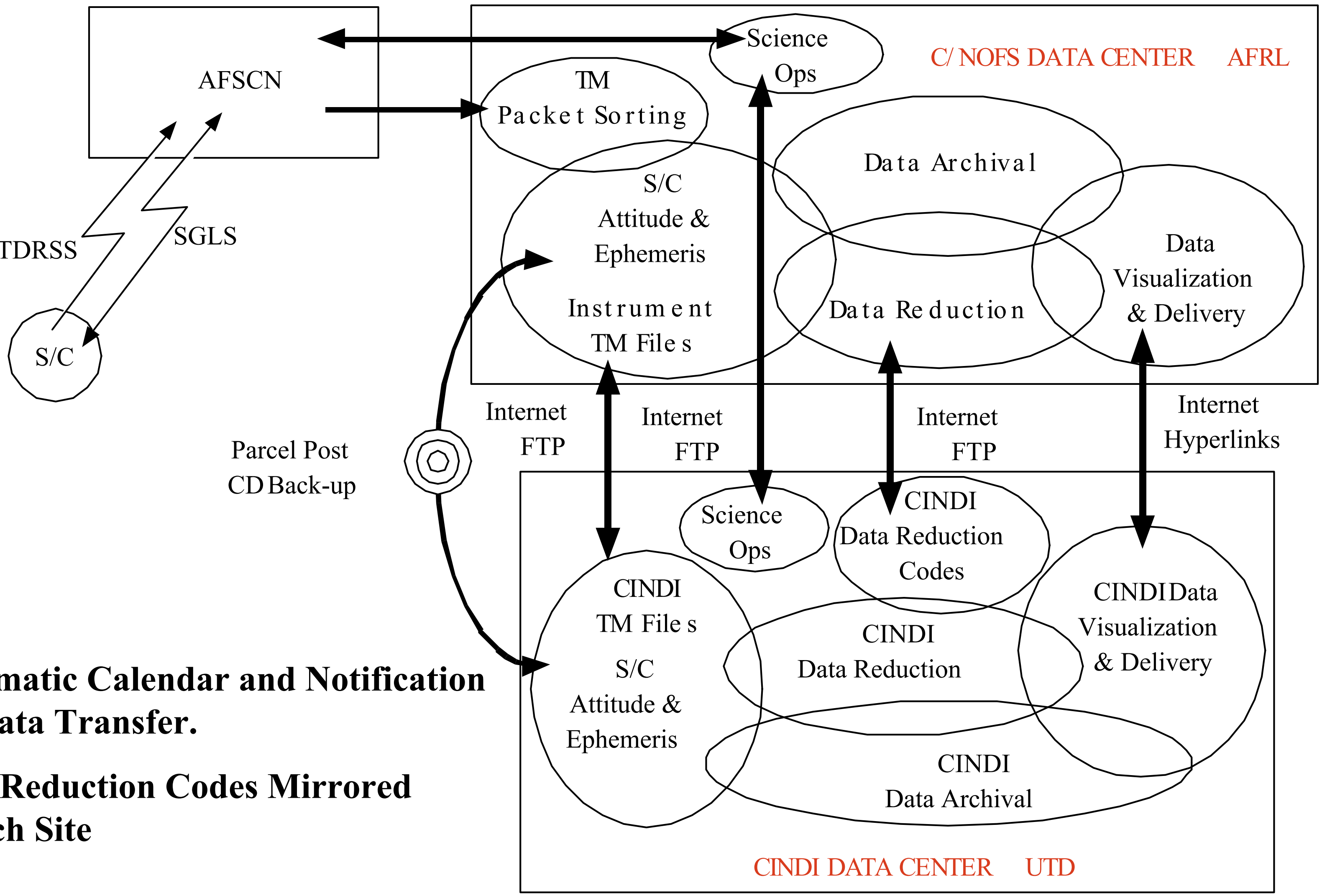
a) NWM

Low Voltage instrument elements on at all times.
High voltage multiplier and filaments turned-on below ~500 km
PE valve operation at fixed time after filament turn-on.

b) IVM

Normal Operations Mode on at all times
No daily command sequences required.

CINDI DATA FLOW



Automatic Calendar and Notification for Data Transfer.

Data Reduction Codes Mirrored at each Site

DATA DISTRIBUTION

- Predicted and Present Satellite Location updated every 20 minutes.
  - Available from web page.

- Data Available 24 hours after access in space.

- Quick-Look Plots produced from IDM only
  - Ni, Local Vertical & Local Cross-Track Ion Drift

- Geophysical Data Records Produced and Accessible within 10 days
  - Level 2 Automatic Algorithms
    - Time Series Plots
    - ASCII Flat Files

DATA ANALYSIS

DATA ANALYSIS

Major Responsibilities

Algorithm Design	
IVM	Heelis & Earle
NWM	Earle & Heelis
Algorithm Execution	Power & Coley
Instrument Behavior	
IVM	Heelis & Earle
NWM	Mahaffy & Earle
Data Quality	
IVM	Heelis & Earle
NWM	Earle & Heelis

DATA ANALYSIS

1. Raw Data

Neutral Wind Meter

a) 16 bit sample -- RWS log electrometer; PE valve open/closed; sync.
b) 16 bit sample -- CTS vert diff amp ; PE valve open/closed; polarity ; sync.
c) 16 bit sample -- CTS horiz diff amp ; PE valve open/closed; polarity ; sync.
d) 16 bit sample -- CTS gauge electrometer ; PE valve open/closed; sync.

Ion Velocity Meter

a) 16 bit sample -- RPA lin electrometer; range ; sync.
b) 16 bit sample -- IDM diff amp ; axis ; polarity ; sync.
c) 16 bit sample -- IDM log electrometer ; sync.

2. Engineering Unit Conversion

Neutral Wind Meter

a) RWS log electrometer -> Equivalent Current and Retarding Potential
b) CTS vert diff amp -> Vertical Neutral Arrival Angle
c) CTS horiz diff amp -> Horizontal Neutral Arrival Angle
d) CTS gauge electrometer -> Relative Neutral Pressure..

Ion Velocity Meter

a) RPA lin electrometer; range -> Equivalent Current and Retarding Potential
b) IDM diff amp ; axis ; polarity -> Horizontal and Vertical Ion Arrival Angle
c) IDM log electrometer ; sync. -> Relative Ion Density

DATA ANALYSIS

3. Derived Data

Neutral Wind Meter

a) Equivalent Current and Retarding Potential -> Neutral Drift Ram Component wrt s/c
b) Vertical Neutral Arrival Angle -> Neutral Drift Vertical Component wrt s/c
c) Horizontal Neutral Arrival Angle -> Neutral Drift Horizontal Component wrt s/c
d) Relative Neutral Pressure -> Relative Ambient Pressure Estimate

Ion Velocity Meter

a) Equivalent Current and Retarding Potential -> Ion Drift Ram Component wrt s/c ; Ion Comp. and Temp.
b) Horizontal and Vertical Ion Arrival Angle -> Ion Drift Vertical and Horizontal Components wrt s/c
c) Relative Ion Density -> Ambient Total Ion Concentration

4. Algorithm Design

Neutral Wind Meter - FORTRAN code also delivered to C/NOFS Data Center

a) Least Squares Fitting Procedure for Neutral Drift Ram Component wrt s/c
b) Removal of Difference Amplifier Offsets for Neutral Arrival Angles wrt s/c
c) Removal of Spacecraft Velocity Vector for Ambient drifts wrt to s/c
d) Rotation of s/c reference axes to Earth Fixed Coordinates.

Ion Velocity Meter - FORTRAN code also delivered to C/NOFS Data Center

a) Least Squares Fitting Procedure for Ion Drift Ram Component wrt s/c
Ion Temp and Composition
b) Removal of Difference Amplifier Offsets for Ion Arrival Angles wrt s/c
c) Removal of Spacecraft Velocity Vector for Ambient drifts wrt to s/c
d) Rotation of s/c reference axes to Earth Fixed Coordinates.

5. Data Products

Neutral Wind Meter - Digital data file in CINDI Data Archive

a) Neutral Wind Vector in s/c coordinates and Earth Fixed Coordinates.
b) Cross Track wind components in s/c coordinates.
c) Measurement location in UT and Earth Fixed Coordinates

Ion Velocity Meter - Digital data file in CINDI Data Archive

a) Ion Drift Vector in s/c coordinates and Earth Fixed Coordinates.
b) Total Ion Concentration, Ion Temperature, Ion Composition
c) Cross Track ion drift components in s/c coordinates.
d) Measurement location in UT and Earth Fixed Coordinates

6. Required Spacecraft and Operations Data

a) CINDI instrument data packets
UT stamped

b) Spacecraft Reference Axes.
Pitch, Roll and Yaw defined wrt spacecraft velocity vector

c) Spacecraft Location in Earth Fixed frame.
UT, Geographic Latitude, Geographic Longitude,
Radial Distance from Earth center.

d) Direction cosines of s/c velocity vector in Earth Fixed frame.
UT stamped

e) Interpolated data required to provide 1/4 second temporal resolution.

PROJECT MANAGEMENT - COST

INITIAL COSTS

- System engineering process based on defining the measurements required to meet scientific objectives
- Developed for WBS on Excel spreadsheets
- Include SOW requirements, match to schedule and develop in WBS
- Bottom-up estimating process
- Derived from past performance
- Compare to other similar instruments and projects of similar complexity
- Quotations on major outside elements
- PI, PM, SE, Mechanical/Thermal Engineer, and Computer System/Software Engineer are primary estimators

COST TRACKING

- Costs reconciled, tracked, and reported monthly out of PM office
- Costs accrued in WBS
- WBS linked to cost reporting system
- Reported on NASA Forms 533M and 533Q
  - Actual costs and future estimates
  - Estimated cost to completion
- Use cost to milestone metric
  - Spending rate and acc. total for salaries and wages per phase per WBS
  - Spending rate and acc. total for significant other items, e.g. parts, subcontracts, purchased services
- Identify and evaluate any projections to completion that exceed budget
- Apply solutions to fit case
  - Monitor
  - Adjust control variables
  - Descope
- Early identification and reaction

CURRENT UTD FUNDING

- Operating on Pre-award provision of Phase B/C/D/E
  - $210k through 31 Aug 01, can be extended a week
- Additional funding of $619k through 15 Nov 01 with Phase B/C/D/E contract signed
- GSFC Co-Investigator funded directly
- $400k S/C IVM Integration Charges paid by NASA

SUMMARY RY COSTS

ITEM	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007	Total RY $K
Phase A								
UTD	220							220
GSFC	30							30
Bridge Phase								
UTD	229							229
GSFC	21							21
Phase C/D								
UTD	442	2653	2424	995				6514
GSFC	22	128	158					308
Air Force	400							400
Phase E								
UTD				919	1070	555	64	2608
GSFC				140	100	66		306
NASA OSS Mission Cost	1,364	2,781	2,582	2,054	1,170	621	64	10,636

CURRENT COST ESTIMATE 1

Cost Element	FY2001	FY2002	FY2003	FY2004	FY2005	FY2006	FY2007	Total RY $K
Phase A								
UTD	220							220
P.Mahaffy (GSFC)	30							30
Reserves								
Total Phase A	250							250
Bridge Phase								
UTD	229							229
P.Mahaffy (GSFC)	21							21
Reserves								
Total Bridge Phase	250							250
Phase C/D								
NWM Instrument	247	1330	429	0	0	0	0	2005
NWM S/C Int & Test	0	0	695	122	0	0	0	817
NWM Pre-Launch Data SW	15	90	153	25	0	0	0	283
IVM Instrument	166	944	202	0	0	0	0	1311
IVM S/C Int & Test	0	39	499	76	0	0	0	614
IVM Pre-Launch Data SW	10	55	107	17	0	0	0	189
E/PO- C/D	0	20	62	10				92
Science Team - C/D	4	26	27	5				63
P.Mahaffy (GSFC)	22	128	158					308
Air Force S/C Int Charges - IVM	400							400
Subtotal C/D before Reserves	864	2631	2332	256	0	0	0	6083
Reserves		150	250	739				1139
Total Phase C/D	864	2781	2582	995	0	0	0	7222
Phase E								
NWM Database Management	0	0	0	327	267	125	15	734
NWM Science Analysis	0	0	0	148	272	157	18	595
IVM Database Management	0	0	0	218	178	85	10	490
IVM Science Analysis	0	0	0	148	273	158	18	597
E/PO- E				52	49	0	0	101
Science Team - E				27	31	30	3	91
P.Mahaffy (GSFC)				140	100	66		306
Subtotal Phase E before Reserves	0	0	0	1059	1170	621	64	2914
Reserves								0
Total Phase E	0	0	0	1059	1170	621	64	2914
Total NASA Cost	1364	2781	2582	2054	1170	621	64	10636

CURRENT COST ESTIMATE 2

- Total Cost estimate unchanged from Phase A Study
- Better definition in some areas, details rearranged
  - Higher parts quality in some areas
  - Back-up parts for quality and schedule mitigation
  - Increase NIAT estimate
  - Above taken from old margin
- Current margin
  - No reserve on
    - Phase A
    - Bridge Phase
    - $400k Air Force cost
    - Phase E
      - Level of effort
      - Intellectual Pursuit of Science Adjusts

Base per above boundary conditions = $5,683k

Reserves = $1,139k

Margin = 20%